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11 Gas-Electric Rail Motor Cars

release 25 steam locomotives

MORE than two years ago, the Minneapolis & St. Louis Railroad Company decided to substitute gas-electric for steam power in order to reduce the cost of operation. To-day, this road operates 20 of its 22 passenger schedules with 11 gas-electric rail motor cars—25 steam locomotives have been replaced—and the company is saving at a rate of more than $300,000 a year. Each rail car averages 118,000 miles per year, and the total annual mileage for the 11 cars is more than 1,300,000.

The Minneapolis & St. Louis is one of 41 American railroads using G-E equipped gas-electric rail motor cars. During the last two years, thirteen of these roads have purchased a total of 52 G-E equipped cars—because substantial savings could be made quickly and surely. For further information, address the G-E office nearest you or General Electric Company, Schenectady, New York.

391-48

GENERAL ELECTRIC

Railway
Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

September - 1932

How Age Affects Locomotive Maintenance Costs *

By Thomas R. Cook

A study of several thousand locomotives made for Baldwin Locomotive Works shows that repair expenditures per unit of potential transportation capacity double in 21 years

REPAIR costs vary with use, size and type of the locomotives, and customary units of "Cost per locomotive year" or "Cost per locomotive-mile" do not permit of a proper comparison as between different railroads or over a period of years for the same line. The first ignores the effect of use, while the second gives no consideration to the size and character of the engine. It has therefore been found necessary to establish a unit which gives due weight to the ability of the modern locomotive to produce high drawbar pull at speed. Extended studies have pointed to the unit of "horsepower miles" as the proper divisor to use in calculating costs of locomotive repairs. Consideration has been given to the use of "tractive force miles" for this purpose, but there are many locomotives with practically identical tractive force that vary greatly in power at certain speeds and necessarily differ in cost of repairs for equal use. The use of horsepower miles has been tested on a large number of locomotives and the results found to be uniformly consistent.

Horsepower, as used for this purpose, must take into account the ability of the plant to make steam and the efficiency of transforming the potential energy in the steam into useful work; further, the calculations should be easily and readily made.

Table I—Factors of Evaporation for Tubes of Varying Lengths

Tube length, ft.	Evaporation, lb. per hr.	Tube length, ft.	Evaporation, lb. per hr.
10.0	13.00	17.5	10.00
10.5	12.75	18.0	9.85
11.0	12.55	18.5	9.70
11.5	12.30	19.0	9.50
12.0	12.10	19.5	9.35
12.5	11.80	20.0	9.20
13.0	11.65	20.5	9.05
13.5	11.45	21.0	8.95
14.0	11.25	21.5	8.80
14.5	11.10	22.0	8.65
15.0	10.90	22.5	8.55
15.5	10.70	23.0	8.40
16.0	10.50	23.5	8.30
16.5	10.35	24.0	8.20
17.0	10.20		

* Abstract of an article which appeared in Baldwin Locomotives for April, 1932.

The ability of the plant to make steam (that is, to evaporate water from the temperature of the feedwater into steam at the working pressure of the locomotive) is dependent in general on four factors:

(a) The amount of direct heating surface contained in the firebox, arch tubes, Thermic syphons and combustion chambers.
(b) The amount of indirect heating surface contained in the flues or tubes.
(c) The length of flues or tubes.
(d) Whether or not the plant is equipped with a feedwater heater, exhaust-steam injector or other means of using available heat in increasing the feedwater temperature.

The efficiency of the transformation of the potential energy of the steam into useful work (tractive force at the rim of the drivers at various speeds), is dependent in the main on two factors: (a) working pressure; (b) degree of superheat.

Horsepower Based on Boiler Capacity

Using only the principal factors involved in the problem as outlined above, we have developed a formula for the determination of horsepower as designated in the unit for measuring repair costs. As the formula does not take distance into consideration, the result of its application is not horsepower in the ordinary acceptance of the word and we have, therefore, referred to it as boiler or potential horsepower.

In application, the boiler or potential horsepower of the locomotive is determined by dividing the total or adjusted pounds of water evaporated per hour by a factor

which represents the normal weight of steam required per indicated horsepower-hour.

In determining the evaporation of water per hour, the following factors are used for direct and indirect heating surface.

1—Fifty-five pounds per square foot is the basis for the direct heating surface, consisting of firebox, combustion chamber, thermic syphons and arch tubes.

2—The evaporation per square foot of indirect heating surface varies with the length of tube, as shown in Table I.

3—The total evaporation of the boiler is the aggregate of that of the direct and indirect heating surfaces. When a feedwater heater is used, this sum is adjusted by an increase of eight per cent.

The factors used as divisors in figuring boiler horsepower vary with the steam pressure, with saturated and superheated steam, and with the degree of temperature of the latter as shown in Table II, or in graphic form in Fig. 1. The factors for superheated steam locomotives are shown for three degrees of superheat, to be used for locomotives equipped as follows:

Type A, original (small) ..... 150 deg.
Type A, improved (large) ..... 200 deg.
Type E ..... 250 deg.

The empirical values used in the preparation of the formula reflect the actual facts. The factors for evaporation are standard, while those covering the use of steam (transformation of energy) are based on various test data and start with the well known figure of 21 lb. of steam per i. hp. hr. for a superheater locomotive at 200 lb. pressure and 150 deg. of superheat (Type A superheater), and with 28-lb. of steam per i.hp. hr. for a saturated locomotive at 200-lb. pressure.

Cost of Repairs Per Horsepower Unit

The determination of potential horsepower for the various classes of locomotives on any given railroad is comparatively simple. In addition to the constants given in the formula, all the information necessary can be found in the locomotive registers of the railroad companies. The actual computations for the determination of the horsepower of 12 locomotives of varying capacities are illustrated in Table III.

The average cost of repairs per horsepower-mile is approximately one-tenth mill. In order to have a repair cost unit that can be easily used and compared, we have adopted 10,000 horsepower-miles, called the "horsepower unit." The average cost of repairs per horsepower unit is, therefore, approximately $1.00.

If a locomotive of 3,000 hp. makes 30,000 miles per year, its performance is as follows:

$$\frac{3{,}000 \times 30{,}000}{10{,}000} = 9{,}000 \text{ horsepower units}$$

If the total cost of repairs of the above locomotive is $10,000, the unit cost will be $10,000 divided by 9,000, or $1.11. The cost per locomotive mile can be derived from the above figures as follows:

$$\frac{\$1.11 \times 3{,}000}{10{,}000} = 33\ 1/3 \text{ cents}$$

An analysis of the cost of locomotive repairs on a number of roads has been made, using the longest period wherein such costs represent present day practice and a fairly constant value. In general, it is found that the railroads have made substantial reductions in equipment maintenance since 1920, reaching an approximately even trend in 1927.

Table II—Factors for Determining Normal Horse-Power

Steam pressure, lb.	Lb. saturated steam	Steam per normal hp.-hr., with superheat of		
		150 deg.	200 deg.	250 deg.
170	29.00	21.75	20.60	19.50
175	28.75	21.65	20.40	19.30
180	28.60	21.45	20.25	19.20
185	28.40	21.30	20.10	19.05
190	28.30	21.25	19.90	18.90
195	28.10	21.10	19.80	18.80
200	28.00	21.00	19.70	18.70
205	27.80	20.90	19.60	18.60
210	27.75	20.80	19.50	18.50
215	27.60	20.70	19.40	18.40
220	27.50	20.65	19.30	18.30
225	27.40	20.55	19.25	18.25
230	27.30	20.50	19.10	18.20
235	27.20	20.45	19.05	18.15
240	27.10	20,35	19.00	18.10
245	27.00	20.25	18.90	18.00
250	26.90	20.20	18.85	17.95
255	26.85	20.15	18.80	17.90
260	26.80	20.10	18.75	17.85
265	26.75	20.05	18.75	17.80
270	26.65	20.00	18.75	17.80
275	26.60	20.00	18.75	17.75
280	26.55	19.95	18.70	17.75
285	26.50	19.90	18.70	17.75

The analyses, as a rule, have covered the years 1927, 1928 and 1929. In making this study the repair cost of each class of power for each year of age was determined. For instance, a group of locomotives purchased in 1917 was ten years old in 1927, eleven years old in 1928 and

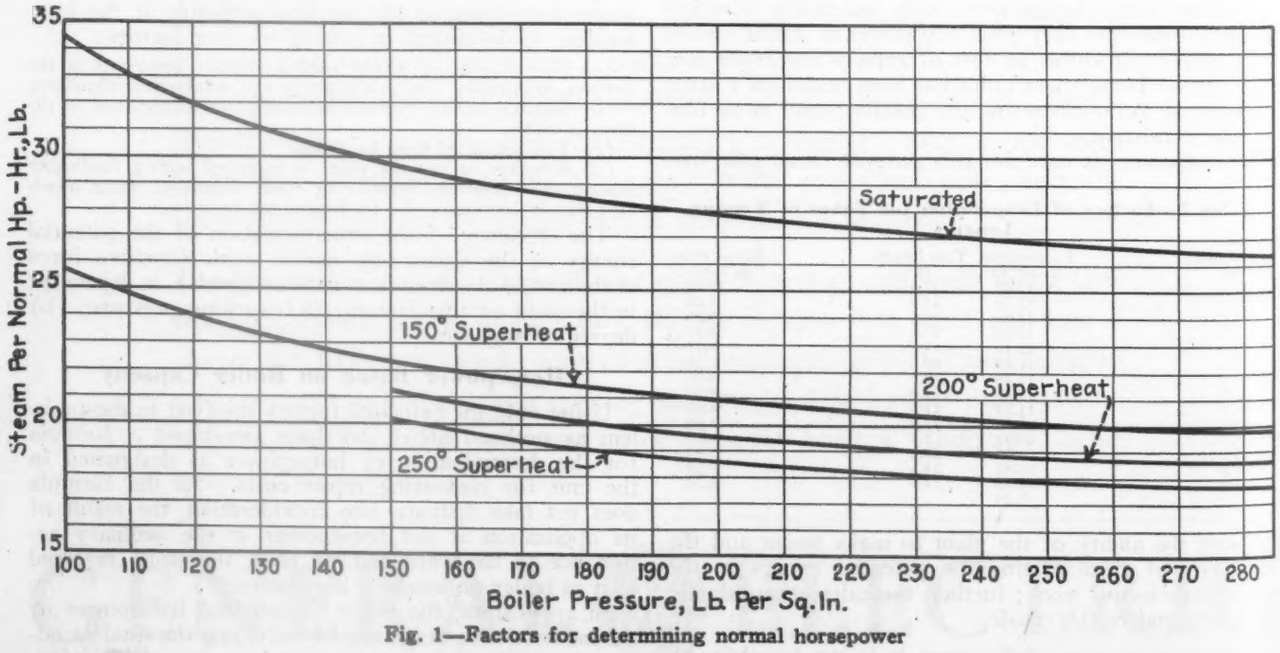


Fig. 1—Factors for determining normal horsepower

twelve years old in 1929. On another group of the same class, purchased in 1920, we would have repair costs for seven, eight and nine years of age. Thus we would obtain costs of maintenance per horsepower unit on this particular class from the ages of seven to twelve years. In this study this range in age varied generally from three to sixteen years.

These compilations indicate a decided upward trend in the cost of repairs with increasing age. This rise is abrupt during the early years with constant but less rapid increase thereafter.

The various classes of locomotives on any one road have shown a uniform repair cost per horsepower unit at the same year of age regardless of the size of the machine, varying from articulated locomotives of 140,000 lb. tractive force to the 2-6-0 type of less than 30,000 lb. tractive force. The trend of these costs varies for individual roads, due to some extent to special operating conditions, but largely to differences in maintenance policy.

The large graph shows the total cost per horsepower unit of 3,370 locomotives covered in this study, com-

Table III—Potential Horsepower Calculations

A	B*	C	D*	E*	F†	G	H	J*	K*	L‡	M	N*	O
Engine No.	Direct heating surface, sq. ft.	Evap., direct heating surface, lb. (B x 55)	Indirect heating surface, sq. ft.	Length of tubes ft. in.	Tube factor	Evap., indirect heating surface, lb. (D x F)	Total evap. per hour lb. (C + G)	Degrees super-heat	Steam pressure, lb.	Steam factor	Hp. (H ÷ L)	Feed water heater	Hp. corrected for F.W.H. (M × 1.08)§
1	199.7	10,984	2,086.8	14-2	11.25	23,477	34,461		190	28.30	1,218	No	1,218
2	175.7	9,664	1,769.8	16-0	10.50	18,583	28,247	150	200	21.00	1,345	No	1,345
3	232.4	12,782	3,446.0	21-0	8.95	30,842	43,624	150	200	21.00	2,077	No	2,077
4	259.6	14,278	3,894.3	21-0	8.95	34,854	49,132	200	185	20.10	2,444	No	2,444
5	325.0	17,875	3,084.0	18-6	9.70	29,915	47,790	200	200	19.70	2,426	Yes	2,620
6	288.0	15,840	4,369.0	20-0	9.20	40,195	56,035	150	200	21.00	2,668	No	2,668
7	313.0	17,215	3,978.0	19.0	9.50	37,791	55,006	200	200	19.70	2,792	Yes	3,015
8	433.0	23,815	4,878.0	21-0	9.95	43,658	67,473	250	250	17.95	3,759	Yes	4,060
9	558.0	30,690	4,656.0	21-0	8.95	41,671	72,361	250	275	17.75	4,077	Yes	4,403
10	598.0	32,890	5,516.0	21-0	8.95	49,368	82,258	250	300	17.55	4,687	Yes	5,062
11	680.0	37,400	6,420.0	24-0	8.20	52,644	90,044	250	250	17.95	5,016	Yes	5,425
12	866.0	47,630	6,800.0	22-0	8.65	58,820	106,450	250	250	17.95	5,930	Yes	6,404

* From the locomotive specifications.
† See Table I.
‡ See Table II..
§ Applied only when feedwater heater is used.

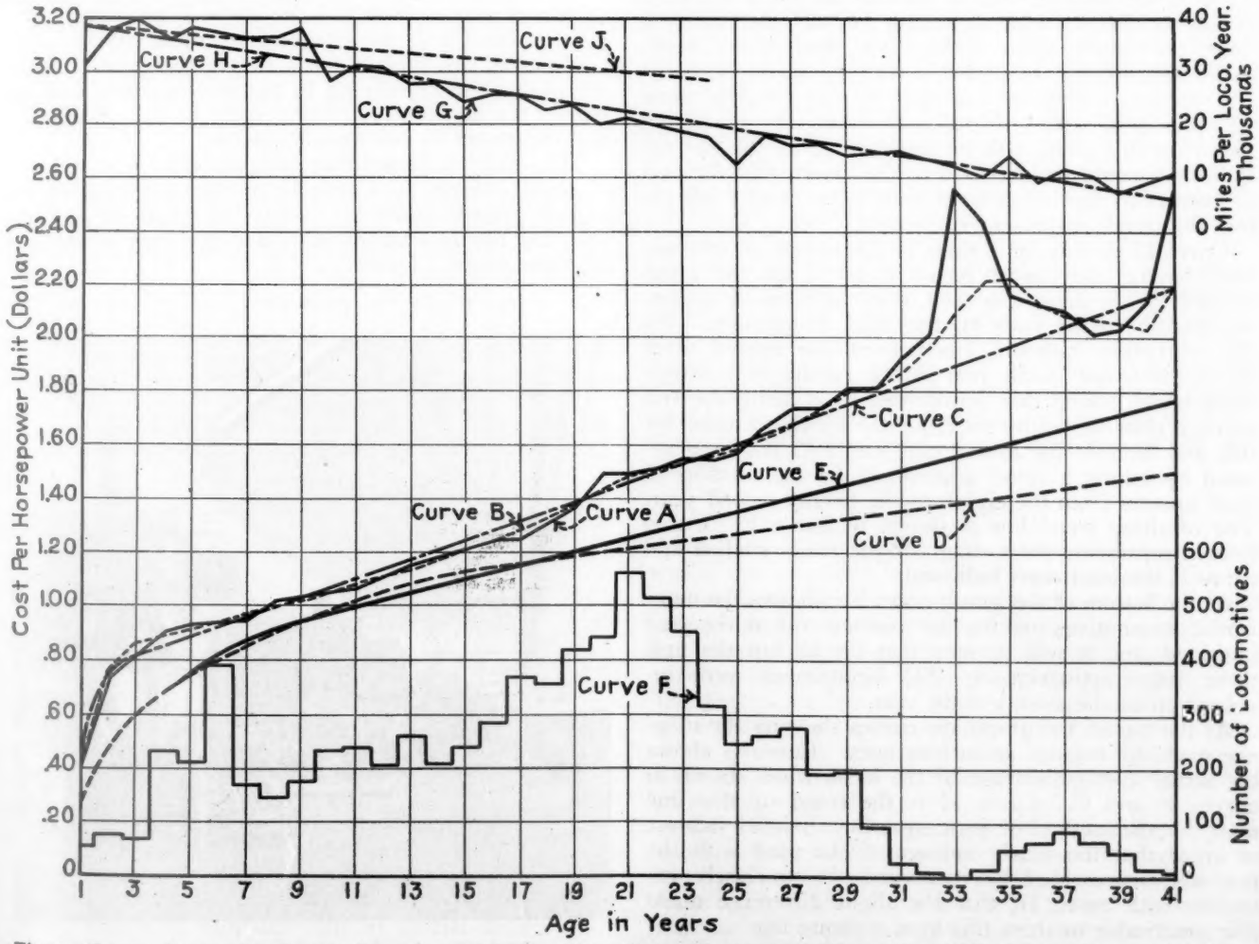


Fig. 2—Composite trends of cost of repairs and locomotive miles with increasing age for 3,370 locomotives representing 8,317 repair years

prising 8,317 locomotive repair years. Curve A is the cost per horsepower unit of all locomotives at the various indicated ages. Curve B is a five-year moving average of the points shown on line A. Curve C is the least square graduation from the fourth to the twenty-eighth year. A smooth curve was extended from the first year, meeting the straight line trend beginning at the fourth year, and the straight line trend was extended beyond the twenty-eighth year.

Curve C reflects the normal cost of maintenance of the locomotives included in our study. It will be noted that the actual costs of repairs to engines over 25 years of age are, with few exceptions, above the trend line C. As a rule, these older locomotives are assigned to branch and minor runs where it is impossible to make large mileage, which fact contributes to a great extent to the erratic costs. It is believed that the trend line C indicates the cost of repairs that would have obtained if the locomotives in question had been kept in regular service.

Use Decreases As Locomotive Repair Costs Increase

The trend line C rises rapidly from the first to the third year. The straight line trend from the third year on indicates an increase in cost per horsepower unit of $.036 per year. On the basis of an average annual cost of $1.07 for the first twenty years of life, this amounts to an increase of 3.4 per cent. Assuming an annual cost of locomotive repairs at $10,000,000 this yearly increment amounts to $340,000.

With the method used in making up the cost curves it follows that the costs of repairs for, say, the twentieth year are based upon locomotives purchased twenty years ago. It is not probable that the maintenance of the modern locomotives will reach as high a cost as those of older design, and, therefore, any savings in repairs based on this trend will be understated as the savings indicated would be increased to the extent that the cost of repairs of the locomotives built today would fall below the trend on present equipment.

Curve D on this same sheet is the record of the railroad having the lowest repair costs of all the roads studied. This curve was used in calculations of savings on specific engine runs on the road in question. On this particular railroad, locomotives are retired after about the twenty-sixth year which results in a downward trend during this period, due to utilizing the full mileage possible before retirement. To compensate for this and indicate the lowest cost, curve D has been revised by taking a trend determined by the method of least squares from the eighth to the twenty-second year. The resulting trend line is shown by curve E. Curve C then represents the average of the roads studied and curve E the least costs indicated.

At the bottom of the graph curve F indicates the number of locomotives making the average cost at the year indicated, and it will be seen that for all but the first three years approximately 292 locomotives were involved up to the twenty-ninth year.

At the top of the graph are curves showing the mileage made by engines at various ages. Curve G shows the actual average mileage of the locomotives shown in curves F and C. Curve H is the trend of this line made by the method of least squares. It is of interest to know that the yearly mileage of the road with the low cost represented by cost curve D so closely coincides with curve H, that the slight difference made it impracticable to show this by a separate line.

The decrease in annual mileage with increasing age is due to a large extent to the transfer of power to less and less important runs. With the modern locomotive, and especially the large power now being purchased for the more important runs with heavy traffic, a reduction in mileage as great as that shown in trend H is not anticipated, as heavy modern power will not be used on branch line service even when old. Exactly what the trend of the new power will be is purely conjectural. For the basis of our calculations we have assumed curve J showing a decrease from 39,000 miles per year in the first year to 30,000 in the twentieth year.

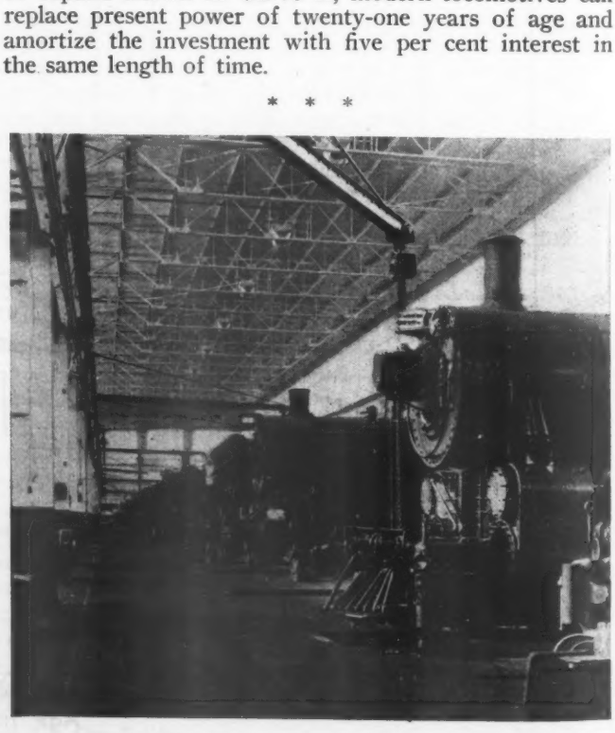
New Locomotives Amortized by Maintenance Savings Alone

With an assumed annual mileage and knowing the cost of repairs at various years of age, the savings to be obtained from repairs alone and the results of application of these savings to the amortization of the investment can be determined on the assumption that a known amount of freight can be handled over a division or engine run at a given speed with the same expenditure of horsepower units whether or not the size or character of the power is changed. This assumption is practically correct; traffic conditions and comparative suitability of the power will cause slight variations in detail application. On the above basis and using the cost per horsepower of $27, we have made a number of determinations which are summarized as follows:

On the basis of mileage curve H and cost curve C, representing the average of all roads studied, we find that with the savings due to repairs only, new locomotives can replace those twenty years old and amortize the investment with a five per cent interest charge in seventeen years. With mileage curve J, but using curve E (the lowest to be anticipated from these studies), new locomotives can replace those twenty-two years of age, amortizing the investment in twenty-one years and can replace the locomotives twenty years of age, amortizing the investment in twenty-four years.

This study indicates that with the relatively low cost of repairs shown in Curve E, modern locomotives can replace present power of twenty-one years of age and amortize the investment with five per cent interest in the same length of time.

* * *



View in the erecting bay of the Point St. Charles Shops of the Canadian National

P. F. E. Builds Seventy-Ton Refrigerator Cars

Steel superstructure framing, a solid steel roof, steel ends, a removable superstructure and waterproof floors are the features of the design built by the Pacific Fruit Express in its own shops

By H. E. Tracy

THE Pacific Fruit Express Company is building in its shops at Los Angeles, California, 100 new refrigerator cars of 70-ton capacity. These cars are the first of this size and capacity to be built by this company and are designed especially for the transportation of frozen berries from the west to the eastern markets. Several innovations in refrigerator car construction are embodied in this design, among which are a light steel superstructure frame, all-steel roof, steel ends and a removable superstructure. The general dimensions and capacities are shown in the table.

The floor racks are of the usual design. However, due to the length of the car, the rack on each side is made in four sections. The width of slats has been reduced to 2 in. in order to give a greater percentage of area for air circulation.

Superstructure

The superstructure frame is of the Pratt truss type. Each truss consists of two frames of five panels each and is constructed of light rolled steel sections. The top and bottom chords are 3-in. by 2-in. by $\frac{5}{16}$-in. angles. The two sections of each truss are tied together over the door opening by angles of the same size as the chords and at the bottom by a 3½-in. by $\frac{7}{16}$-in. strap, set into the side sub-sill beneath the threshold plate. The posts are 3-in. by 2-in. by $\frac{5}{16}$-in. angles and the diagonals are 3½-in. by $\frac{5}{16}$-in. and 4-in. by $\frac{5}{16}$-in. straps. The posts and diagonals are connected to the top and bottom chords by $\frac{5}{16}$-in. gusset plates.

General Dimensions of New P. F. E. 70-Ton Refrigerator Cars

Length inside	50 ft. 5 in.
Length between ice tanks	42 ft. 6 in.
Width inside	8 ft. 10 in.
Height, top of floor covering to ceiling	7 ft. 6 in.
Height, top of floor rack to ceiling	6 ft. 11½ in.
Length, inside to inside of end sills	51 ft. 6⅜ in.
Width over side sills	9 ft. 9¾ in.
Length, inside to inside of coupler knuckles	55 ft. 0⅝ in.
Distance, center to center of trucks	41 ft. 6⅝ in.
Width over sheathing	10 ft. 1½ in.
Extreme width	10 ft. 8 in.
Width at eave	10 ft. 3 in.
Height, top of rail to platform eave	13 ft. 1½ in.
Height, top of rail to top of running board	13 ft. 7⅛ in.
Width, side door opening	4 ft. 0 in.
Height, side door opening	6 ft. 2¾ in.
Cubic capacity between ice tanks above floor racks	2,612 cu. ft.
Capacity of ice tanks	13,200 lbs.

The steel superstructure frame is secured to the side sill by means of shoulder bolts of special design which pass through the side sub-sill and side sill. The entire body of the car can be removed from the underframe without disturbing the floor insulation, thus greatly facilitating underframe repairs and reducing maintenance expense.

Two belt rails are used and these are in sections cut between the steel frame posts and secured thereto by clips and bolts. The belt rails are gained out for the diagonals. Wood fillers for nailing the insulation are bolted to each side post. Douglas fir side plates rest on top of the steel frame and are secured at the ends, by corner bands, to wood end plates bolted to the steel ends.

Roof Construction

The roof is of the solid steel type with outside pressed carlines and metal running board brackets and is furnished by the Standard Railway Equipment Company. The ceiling and roof insulation are supported by fourteen fir ceiling supports, the ends of which are tenoned into the side plates. A ¾-in. dia. tie rod is placed at every other support. The ceiling supports are 3 in. by 4 in. at the center, but the top is sloped toward the side plate in order to avoid compressing the insulation except at the side plates.

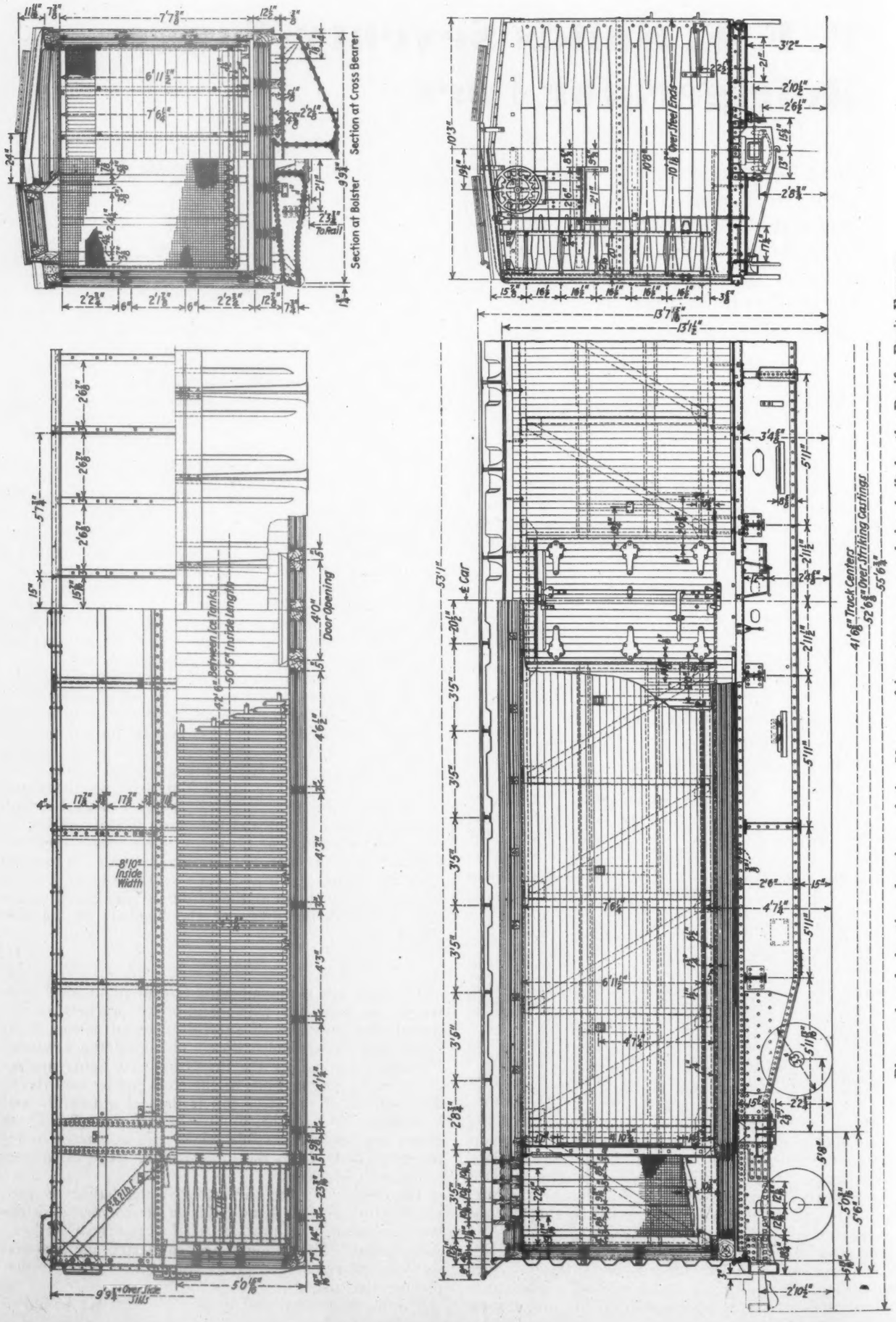
The ceiling insulation consists of two courses of 1-in. Hairinsul insulation laid on top of the 25/32-in. ceiling and fitted in between the ceiling supports; one course of ½-in. board-form insulation laid on top of the ceiling supports and four courses of 1-in. and one course of ½-in. Hairinsul on top of the insulation board. The Hairinsul is secured by nailers at the side plates and hatch-way carlines only. An inverted T-shaped section made of 1-in. fir, which is placed on top of the insulation under the ridge of the steel roof, is continuous between hatch-way carlines and is secured thereto by bolts and clips. This reduces the tendency of the insulation to bunch up at the center of the car with the consequent tearing away of the blankets at the side plates.

Steel Ends

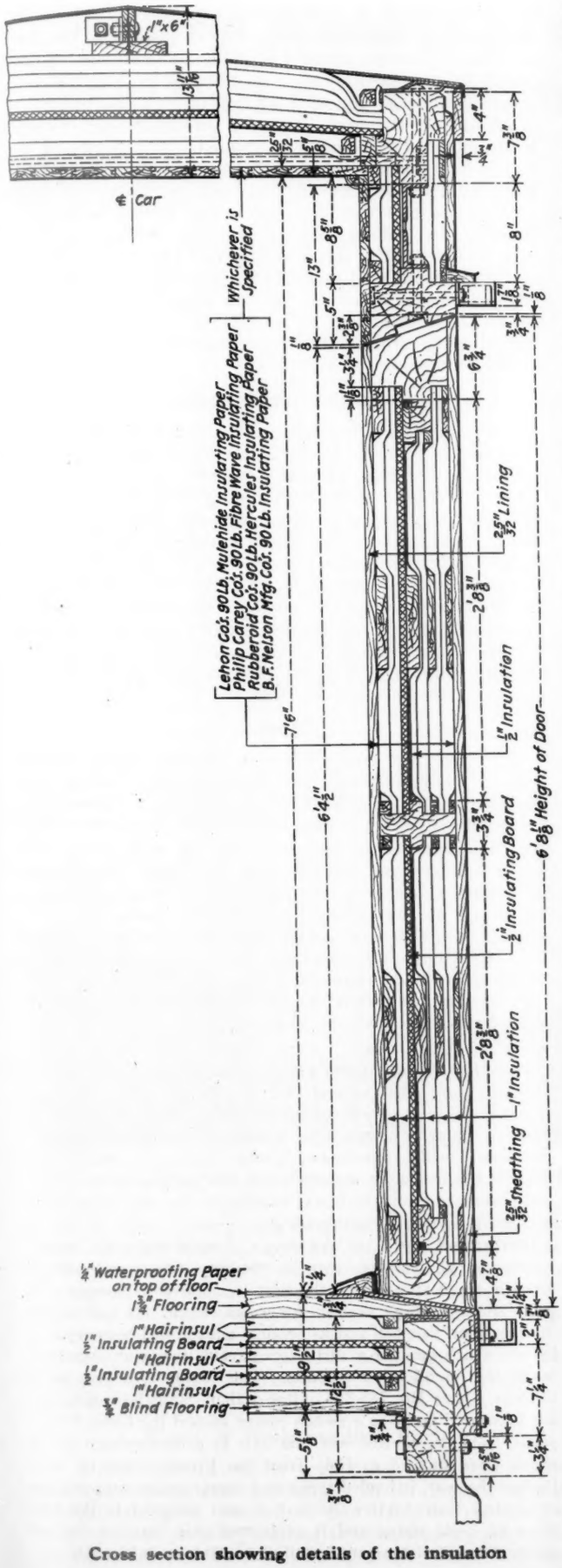
The cars are equipped with Dreadnaught steel ends which are provided with hand-brake brackets so designed that any one of several types of power hand brake can be applied without changing the brackets. Fir fillers for nailing the insulation and lining are secured in the corrugations of the steel end by stud rivets. The bottom of the steel end is flanged outwardly and is riveted to the top leg of the channel end sill. These rivets are easily accessible when it is necessary to remove the body from the underframe. A pressed-steel brake step is used.

The corner of the car opposite the ladder is provided with two side hand-holds in accordance with the latest recommended practice of the American Railway Association. The ladders are supported on brackets and can be readily removed for repairs without disturbing the insulation.

The fir door posts and header are securely bolted to



Plan, end and elevation drawings of the 70-ton refrigerator cars now being built by the Pacific Fruit Express



Cross section showing details of the insulation

the steel frame. The doors are of standard P. F. E. construction and are equipped with Miner locking devices and La Flare door insulation. The door opening is provided with a ¼-in. metal threshold plate which is bent down on the outside of the side sub-sill and secured by screws on the top and bolts through the sub-sill below the blind flooring. The threshold plate can be readily removed without disturbing the floor insulation should it be necessary to renew the lower door lock keeper which is riveted to the plate. This design of threshold plate also serves as a protection against damage due to trucks backing into the side of the refrigerator car.

A beveled piece, the top of which is 1½ in. above the floor, is set into the floor at the door opening and extends a short distance past the door posts. This prevents the water which accumulates on the floor due to body icing, from running out the doorway. A sealing strip made of a doubled strip of canvas wrapped around a ¼-in. hemp rope is secured to the front of this beveled piece and bears against the inside face of the door when closed making an effective seal.

Underframe

The underframe is of all steel construction and the center sill is of the fish-belly type 2 ft. 6 in. deep at the center. The ⅜-in. web plates are continuous between striking castings and are reinforced, at the ends, by ⅜-in. plates extending from the first needle-beam to the striking casting. Two ⅜-in. by 20-in. top cover plates are used, the bottom plate extending the full length of the 3-in. by 3-in. by ⅜-in. top center sill angles and the top plate extending a short distance past the first needle beam from the bolster. The center-sill bottom angles are 4 in. by 3 in. by ¾ in. The outside angles extend the full length of sill and the inside angles stop a short distance outside of the first needle beam from the bolster.

Two cross-bearers are used and consist of $\frac{5}{16}$-in. pressed-steel diaphragms and ½-in. by 6-in. top and bottom cover plates. Pressed center-sill stiffeners of $\frac{5}{16}$-in. plate are placed between the center sills at each cross-bearer. The car has four needle-beams, made of 10-in., 25.4-lb. I-beams, two of which are located between the bolsters and cross-bearers and two between the cross-bearers 2 ft. 11½ in. each side of the center line of car. The bolster consists of ⅜-in. pressed steel diaphragms and ⅝-in. by 20-in. top and bottom cover plates.

The body side bearings are reinforced by steel castings riveted between the bolster diaphragms. Roping and jacking castings are provided at the bolster ends. The rear draft lugs are cast integral with the bolster center filler. The front draft lugs and striking casting are also cast in one piece and the casting is designed for use with the Union coupler centering device furnished by the Union Metal Products Company.

The end sill is made up of a 4-in. by 4-in. by ⅜-in. angle riveted to an 8-in., 13.75-lb. channel and is provided, at the ends, with cast push-hole pockets. The pocket on the ladder corner is designed to serve also as a ladder bracket for the side ladder. The side sills are 4-in. by 3-in. by ⅜-in. angles. Diagonal braces of 6-in., 8.2-lb. channel are used at the corners of the underframe.

Draft Gear

National, Type M-17 friction draft gears, furnished by the National Malleable & Steel Castings Company, are used. The couplers are A. R. A. Type E. with 6¼-in. by 8-in. shank and are bottom operated. A

rotary type uncoupling arrangement furnished by the Union Metal Products Company is used.

Ice Tanks

The ice tanks are of the basket type and have an ice capacity of 13,200 lb. The ice grates and steel bulkheads are the Equipco design furnished by the Equipment Specialties Company. The grate bars are sloped 6 in. from the bulkhead toward the end of car in order to insure proper drainage into the floor pan which is of the depressed type and made of No. 12 gage galvanized steel. P. F. E. Company's standard well traps are used. The bulkhead pad is of the non-insulated type and is made of 1¾-in. tongue-and-groove fir and extends from 14½ in. above the floor to 17 in. from the ceiling. A sheet of asphalt-treated felt is placed between the steel bulkhead sheets and the wood.

The hatchway opening is 22¼ in. by 28¼ in. which is standard P. F. E. practice. The fir framing around the hatch opening, however, has been increased in thickness to give a more rugged construction at this important point. The hatch plug has been increased in thickness to $7\frac{9}{16}$ in. in order to accommodate the necessary insulation which consists of five 1-in. and one ½-in. courses of Hairinsul insulation and one ½-in. course of board-form insulation.

Insulation

The insulation in the side and end walls consists of five 1-in. and one ½-in. courses of Hairinsul insulation and one ½-in. course of board-form insulation. The two outside courses of 1-in. insulation are continuous from door post to corner post. One 1-in. and one ½-in. courses are fitted between the steel frame posts. The three 1-in. and one ½-in. courses on the ends of the car are each in one piece. The ½-in. board-form insulation is applied just inside the steel frame on the sides and inside the Hairinsul on the ends of the car and the two inside courses of 1-in. Hairinsul are continuous between the door posts. The side door insulation is the same as in the side walls. Heavy insulating paper is placed over side wall insulation before the siding and lining are applied and also on top of the ceiling boards and inside of the steel ends. The Hairinsul is furnished by the Johns-Manville Company.

Floor Construction

Straight-edge fir flooring, ¾ in. by 3¼ in. is laid on top of four 3¾-in. by 5⅛-in. stringers and is supported, at the side sills on 1½-in. by 1½-in. by $\frac{3}{16}$-in. angles bolted to the sub-sills. The insulation consists of six 1-in. courses of Hairinsul insulation and two ½-in. courses of board-form insulation, two courses of Hairinsul alternating with one course of board-form insulation. An additional course of ½-in. board-form insulation is laid on top of the Hairinsul directly below the ice tank floor pan. Asphalt treated felt extending from the end lining to the bulkhead post rail and between the side sub-sills, is laid on top of the insulation before the door pan is applied. Every two courses of Hairinsul are secured to the floor stringers and side sub-sills by compression strips making a firm foundation for the 1¾-in. by 5¼-in. tongue and groove fir flooring which extends between bulkheads only.

A 12-in. strip of saturated water-proofing felt is cemented on top of the floor at the bulkhead and laps 2 in. on the bulkhead post rail. A No. 18 gage galvanized flashing is applied on top of the felt and extends over the post rail and down into the depressed floor pan. The entire floor and coping boards at the sides of the car are given a coat of cold asphalt cement over which the first course of waterproofing left is applied. The felt is applied in strips about 3 ft. wide and extends the full width of car, turning up 3 in. into the coping board at the side walls of the car. A second coat of cement is mopped over the first course of waterproofing felt and a top and heavier course is applied. The joints of the top course are staggered with those of the first course. Both courses of felt are cut out for bulkhead posts and extend into the floor pan. The felt is secured by bending the flashing back up over the overlapping edge. The surface of the felt is then given a light coat of cold asphalt cement, well sanded and thoroughly rolled. The edges at the sides of the car are secured in the coping board by a moulding. The waterproofing felt is furnished by the Johns-Manville Company and has a total finished thickness of ¼-in.

Brake Arrangement

The air brake equipment is the New York Air Brake Company's type K. D. 4-12 having a 12-in. by 12-in. cylinder and a 4-in. auxiliary cylinder for taking up the slack. A double-pressure retaining valve is used. The cars are equipped with the Universal One Hand type power hand brake. The cars are also equipped with air signal and steam-heat piping in case they should be used in passenger train service. With the exception of the short nipples at the ends of the train line, which are standard pipe, all piping is extra strong steel pipe. The air brake, signal, and steam-heat pipes are secured by angle clips and U-bolts. Steam heat pipes are covered with insulation 1 in. thick.

Trucks

The cars are equipped with 70-ton trucks having 6-in. by 11-in. journals and U-section side frames conforming to the latest A. R. A. requirements. The trucks are equipped with Creco four-point supports, Creco No. 3 brake beams, Schaefer bottom rod, levers and brake hangers and friction side bearings. The brake-beam hanger brackets are provided with steel wear plates furnished by the Schaefer Equipment Company. The Barber lateral motion device, furnished by the Standard Car Truck Company, is used. The outside center spring of each A. R. A. standard cluster P is a Type A friction spring furnished by the Cardwell-Westinghouse Company. Steel wheels are used.

THEY KEEP ON STEALING LOCOMOTIVES.—There seems to be a veritable crime wave around railroad roundhouses. The latest report of the theft of a locomotive comes from Carrizozo, N. M., where a young Mexican, who wanted a ride, walked into the Southern Pacific roundhouse, climbed into a locomotive and drove it 800 feet down the track. At this point a mixed freight and passenger train which was standing in the way brought the Mexican's joyride to an abrupt end.

DISTINCTION FOR AN AMERICAN LOCOMOTIVE.—No matter where you go, you are sure to run into American products. Even in the Vatican City, the first locomotive to operate over the Vatican Railway was an American engine. It had neither "cow-catcher" nor bell and its original whistle had been replaced by one which emitted a shrill squeak, but it was an American locomotive in all other respects. The engine is a veteran of the war. It is No. 735-210 of the Italian State Railroads, and has been used lately as a switch engine around the Rome freight yards. The locomotive was one unit in a consignment of 50, which were shipped to Italy from the United States in 1918. During the war, it hauled troop and supply trains into and out of Central Italy. After the war, it was assigned to the handling of royal trains and it performed this duty to the full satisfaction of all concerned until its transfer to yard work.

Roller Bearings on Railroad Equipment

Application and performance of roller bearings on locomotives and cars are discussed at the Bigwin, Ont., meeting of the American Society of Mechanical Engineers—Paper by T. V. Buckwalter sponsored by Railroad Division

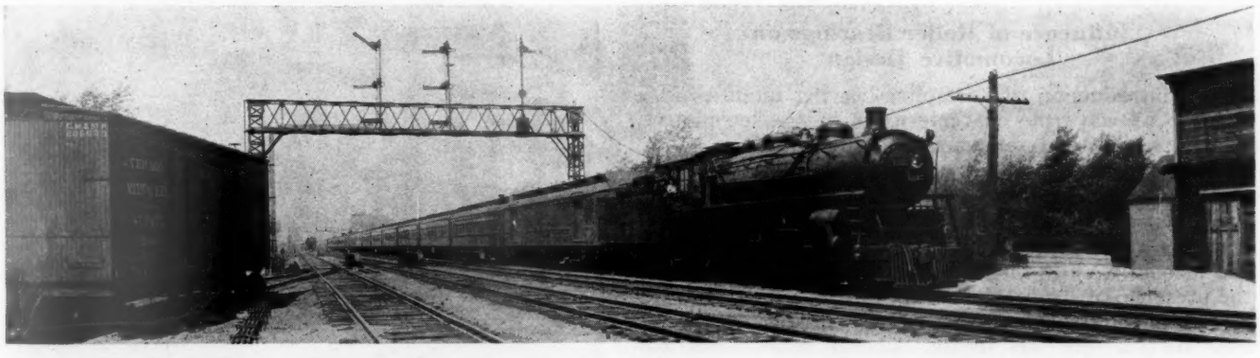
ONE of the papers presented at the spring meeting of the American Society of Mechanical Engineers, which was held at Bigwin, Ont., June 27 to July 1, inclusive, was a paper by T. V. Buckwalter, vice-president, Timken Roller Bearing Company, Canton, Ohio. A considerable portion of this paper, which was sponsored by the Railroad Division, was a report of the performance of the roller bearings on Timken locomotive No. 1111. A complete report of the application and performance of the bearings on this locomotive was published in the March, 1932, issue of the *Railway Mechanical Engineer,* page 91. Other articles describing the Timken locomotive appeared in the June, 1930, issue, page 316, and February, 1931, page 74. Following is an abstract of Mr. Buckwalter's paper:

The Timken Locomotive—Specifications

The Timken locomotive is a composite of specifications of a number of trunk-line railroads and was built as large and powerful as the clearance limitations of the principal railroads of the United States would permit.

The driver application was made without adjustable mechanism. Hardened-steel trunnion guides are mounted on the bearing housing centrally pivoted to permit of the housing following track irregularities while maintaining full surface contact with the hardened-steel liners on the locomotive frame.

The forces due to piston thrust, therefore, are transmitted and absorbed in a complete train of moving parts composed of hardened steel. These comprise the pedestal liner, trunnion guide, hardened wear plates on the bearing housing and the inner and outer races of the bearing, together with the rolls. The complete housing of the driving axles and use of bearings restraining the axle on a complete circle at 360 deg. eliminates pounding while under steam and while coasting, and, together with careful proportioning of the reciprocating parts, permits of operation of 73-in. drivers at speeds of 85 m.p.h.



One of the eight "Olympian" trains on the C. M. St. P. & P., the cars of which are equipped with Timken bearings

Wear of Reciprocating Parts

The crosshead guides and valve links operate in open atmosphere and are subject to the lapping action of dust and grit. An effort was made to reduce the wear of these parts by making the crosshead guides and the valve links of Timken bearing steel. This steel has a tough core with approximately 6 per cent alloy and is cased approximately ¼ in. deep to eutectoid to develop a surface material of exceptional wear-resistant characteristics. The crosshead slipper is lined with tin, this permits atmospheric dust to imbed in the soft tin and avoid cutting the crosshead guide, and in addition, the guide is of sufficiently hard material so that atmospheric dust and grit, composed largely of silica, does not wear and abrade the guide. The experience of two years indicates the soundness of this selection of materials as the crosshead guides show very little evidence of wear and have taken on an exceedingly high polish of great hardness.

The link and link block of the same material and treatment have about .010-in. looseness after two years and have not received any attention and do not now require any. It is of interest to note that the crosshead slipper operates at a temperature of 20 deg. to 30 deg. above atmosphere.

The side-rod bearings are of the floating bushing type. The main and main side-rod floating bushings are of the conventional type. Pins Nos. 1, 3 and 4 have hardened bearing-steel bushings pressed in the rods. These bushings have a spherical bore of a radius approximately equal to the distance between the wheels. A floating bronze bushing operates between the pin and the fixed steel bushing. It has paralleled bore and the outside diameter crowned approximately the same as the spherical bore of the steel bushings. This results in an equal distribution of wear on the pins and may have assisted in prolonging the life of the pin bearings.

The reciprocating parts were given special thought and were reduced in weight in accordance with the best American practice. The specifications given the builder called for a speed of 85 m.p.h. with a dynamic augment not exceeding 10,000 lb. This is 13 miles in excess of diameter speed and was made available by the use of low-carbon nickel steel, according to specifications of the International Nickel Company, in the main rod, side rods and pins; the use of the hollow piston rod, heat-treated carbon steel, following Pennsylvania practice; the use of Locomotive Finished Material Company's piston and ring construction, and the use of nickel-vanadium heat-treated steel castings for crossheads, of a composition developed by the Union Steel Casting Company. The total reduction in the weight of reciprocating parts per side under conventional practice for locomotives of similar capacity, is 460 lb.

The drivers were cross-balanced with approximately one-half the over-balance on the main drivers and the other half of the over-balance distributed on Nos. 1, 3 and 4 pairs.

Table I—Starting Effort Over 72,000 Lb. from Erie Tests

Test No.	Mile post	Drawbar pull, dynamom. car roll	Grade correction	Actual effort, lb.	Factor of adhesion	Tons in train
134-A	167	80,640	+6,072	86,812	3.72	2,348
134-B	64	75,000	—2,508	72,492	4.46	2,603
135-B	255	77,200	—1,650	75,550	4.27	2,137
136-A	206	82,520	+5,428	87,998	3.68	2,697
137-B	201.75	76,100	— 264	75,836	4.26	2,107
132-A	239.2	71,500	+4,554	76,054	4.25	....
132-A	284	73,200	+ 990	74,190	4.35	....
132-A	239.1	72,500	+3,432	85,732	4.27	....
129-A	164.75	72,500	....	72,500	4.45	2,602

Total weight on driver plus weight on rear booster axle = 264,000 lb. + 59,000 lb. = 323,000 lb.
Booster used in all of the above starting efforts.

The detailed attention given to the reciprocating parts and the balancing system, together with the complete housing of the axles of the roller bearings, produced a locomotive of exceptionally smoother operating characteristics. The operation at 70 m.p.h. is exceptionally smooth and vibration is not excessive at 85 m.p.h.

Influence of Roller Bearings on Locomotive Design

The introduction of the roller bearing modifies in a number of ways the characteristics of the locomotive, which can be briefly enumerated.

Thrust plates are eliminated entirely. The thrust reactions due to curvature or flange thrust from any cause are taken on the roller bearing surfaces of the tapered bearings and no provision need be made anywhere in the locomotive for thrust plates. Maintenance due to the presence of thrust plates is eliminated entirely.

The engine-truck wheels do not require the large hub surface on the inside, wheels of symmetrical design having hub diameters the same on both sides of the web, similar to those used in tender service, providing the best construction for roller-bearing engine trucks. This provides a stronger wheel inasmuch as the heat treatment is more uniform; the cost is reduced and likewise the unsprung weight. Four years' experience, indicates an increase in life of the engine-truck wheels. The life of the wheel is limited by tread wear only. The heat rise of the bearings is about 15 deg. and consequently checking of the thrust surfaces of plain bearings is entirely eliminated. A number of engine trucks have operated in excess of 400,000 miles without wheel replacements.

Axles can be selected for stress and deflections only; no provision need be made for wear. The temperature rise varies from 15 deg. at the front end of the engine to 40 deg. and 50 deg. under the tender. No provision need be made in the axle as regards increased diameter to provide for wear. Use of the roller bearing will permit the axle to be made of alloy steel with treatment to develop the superior physical properties of alloy steel, the reason being that the axles are not subject to heat checks due to daily cycles of high temperature and ultimate cooling. The axles on the Timken locomotive are composed of carbon-vanadium normalized steel. The driving axles were made of uniform diameter, 11½ in. This reduced the diameter of the main from 1 in. to 1½ in. under corresponding plain bearing equipment.

The Timken Locomotive Operating Characteristics

The reduction in vibration following the use of roller bearings indicates a reduced maintenance expense on account of the noticeable absence of loose bolts and loosened clamps and broken pipe connections, these features being frequently commented on by railroad men servicing the locomotive.

The factor of adhesion is modified in certain respects with the introduction of the roller bearing on the driving wheels. A higher percentage of the piston thrust is communicated to the drivers at the point of contact with the rail and consequently the power input to the locomotive for given drawbar pull is reduced. A saving in friction can be conservatively estimated at 12 per cent. The reductions following this modification would be that the adhesion factor should be slightly higher, if the locomotive was not modified in any other respect, and, on the other hand, the experience to date would indicate that the cylinder capacity could be reduced in accordance with the saving in friction.

The temperature rise on the driving-wheel bearings is from 15 to 20 deg. above atmosphere

Probably the best compromise would be to split the saving in power and put one-half of it in reduced cylinder capacity and the other half in reduced factor of adhesion. The adhesion factor of the Timken loco-

motive is 4.14. This gives uniformly good service but comment has been made of slipperiness under bad rail conditions.

The subject has been carefully studied and opinions of experts on the subject sought. The opinion of one locomotive expert was that locomotives have always slipped and always will slip under certain conditions, even though the factor be made 100 to 1. The fact that the roller-bearing engine is new has made it a target for criticism on any point that is even slightly different from conventional practice and, if a slip would occur, it would be blamed on the roller bearings even though plain-bearing engines had slipped over identical track for one-hundred years under certain atmospheric conditions.

An interesting passenger run, which was repeated twice, was that of hauling 18 passenger-equipment cars, including 13 Pullmans, over the Ozark Mountain grades on the Missouri Pacific between St. Louis and Poplar Bluff. These runs encountered maximum grades of 2.1 per cent and the practice followed was to approach the grades at speeds of 50 m.p.h. and as the speed fell the booster was dropped in at 22 m.p.h. and in the three runs the train was handled over the top of the grade at speeds of 15, 17 and 19 m.p.h. These trains averaged 1,260 to 1,290 tons, and indicate with the booster a tractive capacity approximating 80,000 lb.

The writer will be pardoned for mentioning a trip

Engine-truck bearings in perfect condition at 303,756 miles

over one railroad over a distance of more than 450 miles following a criticism on account of slipping. The writer observed the entire distance with full-tonnage train and noted only a slip of half-dozen revolutions on poorly maintained curved track at the ladder of a yard. On the other hand, the writer has often noted trains where the plain-bearing engine has slipped to a standstill on account of atmospheric conditions, yet no comment was made except to apply more sand.

The starting characteristics of the locomotive on roller bearings is materially changed. The Timken engine has a normal starting drawbar pull of 63,700 lb. based on the conventional formula. It has been frequently observed to develop a starting force of from 68,000 to 69,000 lb. Table 1 showing tests on the Erie gives the data on a number of starts in excess of 72,000 lb. with the booster. Some of these starts are in excess of 80,000 lb., the maximum being 87,998 lb. The start at M.P. 206 is an example and illustrates the high momentary surge at starting; the sustained power in starting is over 80,000 lb. The added starting power contributed by the roller bearing is of particular value and adds to the capacity of the locomotive in handling heavy trains.

The absence of friction in starting the locomotive, weighing 711,000 lb., adds an equivalent amount of weight that can be started without jerking. This is equivalent to five Pullmans.

The normal temperature rise of the bearings varies from 15 deg. on the engine truck to 40 deg. to 50 deg. on the tender, the interesting feature being that the temperature rise of the drivers is only 15 deg. to 20 deg. above atmosphere. The normal condition of the bearing housings in zero weather is with frost adhering to the bearing housings and the end of the axles. One of the illustrations shows the condition of frost adhering to the driving axles.

The maintenance work consists of the normal engine-house attention, including the replacement of rod bear-

Table II—Performance of Main- and Side-Rod Bushings on the Timken Locomotive

	Back-end main		Main side rod		Front wheel		Back int.		Back wheel	
Mileage	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
144	....	....	....	....	(1)	....	....	....	(1)	....
1,462	(2)	....	....	....	....	....	....	....	....	....
2,098	....	....	....	....	(3)	....	....	....	....	....
6,582	....	....	....	....	(4)	(4)	(4)	(4)	(4)	(4)
42,010	....	....	....	....	....	(5)	....	....	....	....
64,653	(5B)	(5A)	(5B)	(5A)	....	(6)	(5)	....	....	....
64,740	(7)	....	(7X)	....	....	....	....	....	....	....
66,112	(8)	....	....	....	....	....	....	....	....	....
69,129	(9)	....	(8)	....	(5)	(6)	(6)	(5)	(5)	(6)
69,651	....	....	(9)	....	....	....	....	....	....	....
73,516	(9)	....	(10)	....	....	....	....	....	....	....
80,146	(12)	(12)	(11A)	(11A)	....	....	(11A)	....	....	....
83,145	....	(11)	....	(13)	....	(5)	....	....	....	....
109,963	....	....	....	....	....	....	(5)	....	(6)	(6)
110,867	....	....	....	(5)	(5)	....	....	(9)	(14)	(14)
116,291	....	....	(9)	....	....	(15)	....	(15)	....	....
119,586	....	....	(16)	(16)	(16)	(16)	(16)	(16)	(16)	(16)

Maximum mileages for any one bushing application: 63,191; 64,653; 69,042; 64,653; 62,547; 35,428; 58,071; 62,547; 62,547; 62,547.

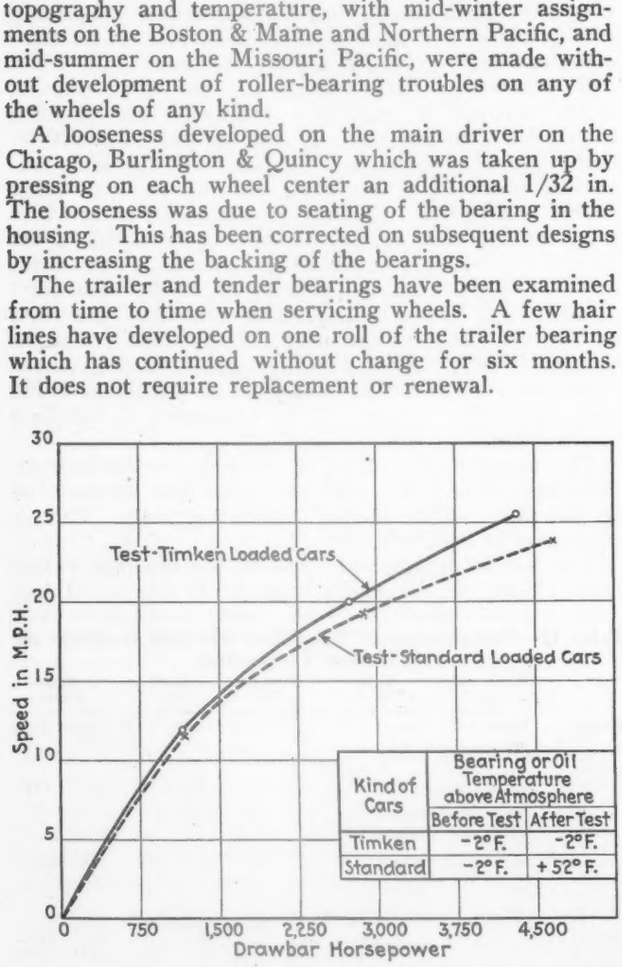
Reasons for renewing rod bushings at mileages indicated in table:

(1) Rods were out of tram
(2) Bushing was thought tight on O.D.; was rebored and then found loose
(3) Not enough lateral
(4) Changed from solid to three-piece floating bushing with crown
(5) Diameter wear
(5A) Diameter wear and changed from floating to three-piece bushing with crown
(5B) Diameter wear and changed from floating to three-piece bushing with crown
(6) Broken bushing
(7) Experimental bushing
(7X) Experimental bushing defective, but replaced; removed at 64,653 miles
(8) Defective casting
(9) Cracked bushing
(10) Crank pin rough and was reground
(11) Replaced with solid floating bushing
(11A) Replaced with solid floating bushing as it was damaged when main crank pin broke
(12) Rebored to fit new pin after right main crank pin broke
(13) Bushing rough
(14) Bushings applied at 109,963 miles; did not have sufficient stock to finish O.D.
(15) Steel bushings were loose. New steel and brass bushings were applied
(16) Bushings damaged account of accident

ings, brake shoes, etc., and it is particularly interesting that the entire demonstration of two years' time involved in the 120,000 miles over every condition of topography and temperature, with mid-winter assignments on the Boston & Maine and Northern Pacific, and mid-summer on the Missouri Pacific, were made without development of roller-bearing troubles on any of the wheels of any kind.

A looseness developed on the main driver on the Chicago, Burlington & Quincy which was taken up by pressing on each wheel center an additional 1/32 in. The looseness was due to seating of the bearing in the housing. This has been corrected on subsequent designs by increasing the backing of the bearings.

The trailer and tender bearings have been examined from time to time when servicing wheels. A few hair lines have developed on one roll of the trailer bearing which has continued without change for six months. It does not require replacement or renewal.



Acceleration test with freight cars showing the relation between drawbar horsepower and speed

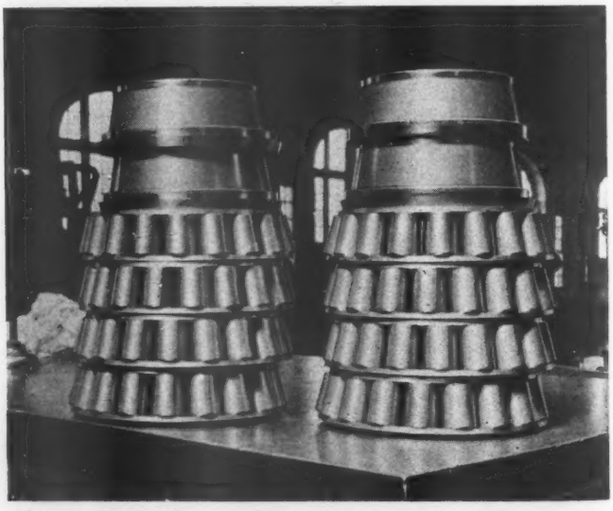
The driving-wheel bearings were removed and minutely examined at the conclusion of the demonstration period. The cups (outer races) and rolls showed no evidence whatever of wear. The driver cones (inner races) showed very slight wear, visible only under a microscope. As a matter of experiment, the removal of .0005 in. metal in regrinding removed the microscopic evidences of wear. The cones have been returned to service without other modifications (some of the cones were not touched) to study further the development of wear. The indications from the study of the bearings at the conclusion of the demonstration period, visualized against the accumulative available information of the service of roller bearings in all kinds of industries, would indicate that the wheel bearings, with the exception of the driver cones, should have a normal life expectancy of 1,000,000 miles, the driver cones having a life expectancy of half that figure. This presumption is further borne out by the study of the condition of the engine-truck bearings after 400,000 miles' service, which show no appreciable evidence of wear, and is supplemented further by the study of the original roller-bearing applications on the Chicago, Milwaukee, St. Paul & Pacific, many of which have now crossed 1,000,000 miles and which have been studied in detail over the past seven years.

One of the illustrations shows an axle assembly of engine-truck bearings having 303,756 miles which were removed from a Michigan Central locomotive. The disassembly was made on account of wheel change and developed the perfect condition of the bearings after two complete shopping periods, approximating 153,000 miles each. These bearings did not show sufficient wear to indicate any reasonable percentage of life expectancy, having been given up in service. A number of engine-truck bearings have been examined with similar results at mileages between 400,000 and 500,000.

The rod-bearing life is apparently increased while operating on roller-bearing drivers. A number of the bushings on each of the main- and side-rod applications, referring to Table II, have operated in excess of 60,000 miles, which is about double the average life expectancy of these bearings. The probability is that rod-bearing life is increased on account of the greater accuracy of alignment of driving axles in the roller bearings.

The availability is definitely increased by the roller bearings. The operation for two years in a wide variety of services without any bearing trouble whatever and which for long periods of time involved the dispatchment of four divisional trips each 24 hr., is an indication that the use of the roller bearing increases the availability of the locomotive by 50 per cent.

The tender is built on a General Steel Casting tender bed and has a capacity of 21 tons of coal and 14,000 gal. of water. It is equipped with a cupola for the accommodation of the owners' observer. The operation of the locomotive and the fuel performance has been modified adversely by the water capacity of the tender, particularly in view of the high steaming capacity of the boiler. The survey of American roads indicated the presence of a number of 90-ft. turn tables at critical points, over which it was desired to operate the locomotive, which by limiting the overall wheel base to slightly



Driving-wheel bearings after two years in service—119,600 miles

less than 90 ft., placed decided limitations on tender capacity.

The performance of the locomotive as regards, increased average speed and fuel economy would have been materially improved had the tender capacity for water been increased to 21,000 gal.

Mechanical Efficiency

Dynamometer car tests were made on the Chesapeake & Ohio, Erie, Lehigh Valley, Nickel Plate and Northern

Pacific. The Lehigh Valley tests were made on the Seneca Division over rolling country. The outstanding feature of these tests was the development of 4,000 drawbar horsepower at speeds in excess of 36 m.p.h. under favorable train and grade conditions.

The mechanical efficiency compiled from test data on the Lehigh Valley and Northern Pacific, varies from 90 to 96 per cent. The high efficiency as indicated on tests, is confirmed by the low temperature rise of the wheel bearings, particularly the driver bearings. This averaged 15 deg. to 20 deg. above atmosphere.

The increased capacity of the roller bearings, as applied to the locomotive varies from 10 to 13 per cent, averaging 12 per cent. A conservative assumption is that the roller-bearing locomotive can be reduced in size 10 per cent to perform equally with plain-bearing locomotives, or, conversely, locomotives identical with a roller-bearing locomotive could be expected to produce an increase of 10 to 12 per cent with roller bearings.

The service-performance record confirms the test data

Side view of truck equipped for grease lubrication

in that the roller-bearing locomotive consistently exceeded the performance of similar sized plain-bearing locomotives with identical cylinders and pressure and equalled, and at times exceeded, the performance of engines having 1 in. to 1½ in. larger cylinder diameter. The plain-bearing cylinder capacity in some cases was 20 per cent in excess of the Timken locomotive.

Economic Value of Roller Bearings

The value of the roller bearing in locomotive construction is reflected in a number of ways which can be enumerated as follows. Some of these advantages can be evaluated and, while others are present and recognized, the definition of value is more difficult to determine.

They are: Reduction in maintenance; reduction in consumption of lubricants; reduction in consumption of fuel; reduction in consumption of water; increased development of power (A conservative figure is 10 per cent) and increased availability (50 per cent).

The above advantages are subject to evaluation and can be capitalized. In addition, the following conditions are present, but are more difficult to evaluate: Increased permissible speed; enginehouse force reduction; elimination of axle failures due to heat checks; and reduction in rod maintenance.

The approximate cost of roller-bearing equipment, including bearings and housings and application parts for the 4-8-4 locomotive, not including the tender, is $8,000.

Bearing-replacement charges on the basis of an annual mileage of 168,000 miles and a life expectancy of wheel bearings, except driver cones, of 1,000,000 miles, and driver cones, 500,000 miles, would be $1,500 a year.

Saving in maintenance and lubrication, based on data accumulated during the roller-bearing locomotive demonstration period on the basis of: Attention during running; maintenance at terminals; semi-monthly inspection; replacement of bearing brasses; replacement of hub liners, and saving in lubrication, would vary from $3,900 per locomotive-year for territory with light grades to $6,700 per locomotive-year in heavy service in mountainous territory.

Net maintenance saving, after deducting the bearing replacement charges, would vary from $2,400 to $5,200 per year.

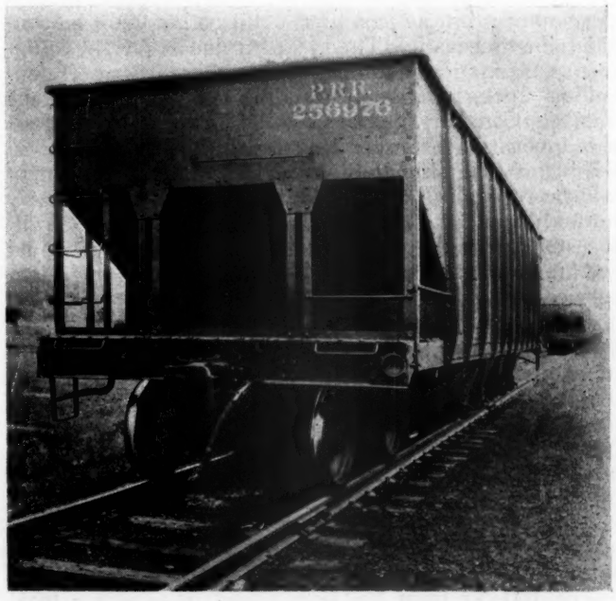
Fuel economy, based on average machine efficiency of 86 per cent for plain-bearing locomotive and 93 per cent for roller-bearing locomotive, would vary from 750 tons to 1,200 tons per year, this representing an annual saving of $1,500 in the lighter service to $2,000 in the heavier service.

Locomotive operating cost would, therefore, be reduced in amounts from $3,900 annually in light service to $7,200 in mountainous service, corresponding with direct returns on investment of 49 per cent and 90 per cent, respectively, the high return corresponding with the greater severity of service.

The return of bearing investment, in addition to economy in operation due to saving in maintenance, fuel and lubrication, would also include a factor on account of increased availability of the roller-bearing locomotive and on account of increase in power, averaging 12 per cent; in conservative figures, 10 per cent.

An increase in availability of 50 per cent on an investment of $80,000 is equivalent to $40,000 to be written off in the life of, say 20 years, or say, $2,000 a year.

An increase in power of 10 per cent on an invest-



Timken inboard trucks under a Pennsylvania 70-ton hopper car

ment of $80,000 can be evaluated at $8,000, which, in a life of 20 years, is worth $400 annually.

The increased value of the roller bearings in locomotives on account of increased power development and increased availability, would be worth approximately $10,000, or considerably in excess of the purchase price of the roller-bearing equipment.

Considerable study has been devoted to the applica-

tion of roller bearings to main and side rods, and methods have been developed that will permit of the application of roller bearings to these parts.

A unique device avoids the transmission of twisting and extraneous loads incident to locomotive operation to the bearings. The application avoids an increase in rotating parts carried on the pins, as compared to plain bearings, on the basis of using carbon steels in the rods. The advantages of the roller bearing, involving long continuous runs, reduction in maintenance, economy in lubrication, are available without sacrificing maximum speed or increasing the dynamic blow on the rails.

An interesting feature of the roller-bearing study is that the main and side rods have practically uniform sections, and permit and facilitate the use of alloy steels, developing higher physical properties. The roller-bearing application on the basis of using alloy steels, effects reductions of 25 per cent in reciprocating and rotating parts, and permits of increases of speed of 12 to 15 per cent with the development of the dynamic augment corresponding with plain bearings with diameter speed.

This increase in permissible speed has a high economic value and improves the position of the railroads as regards meeting competition of other forms of transportation. The higher speeds will permit of reducing train schedules to the extent of 10 to 15 per cent, and will place the railroads in a position more in keeping with present-day economic demands for high speed.

Applications to Freight Equipment

Freight-train equipment presents a field for the application of roller bearings, which, in value to the railroads, should rank next to the successful application to the locomotive. The development of the freight-car application has been slow. The reception of this development on the part of the railroads cannot be considered enthusiastic. The great surplus of freight equipment has practically stopped the purchase of new freight rolling stock, but notwithstanding these conditions the Timken Company has anticipated the development of the application of roller bearings to the freight car in the belief that ultimately the value of the development will be recognized and, with the return to more nearly normal business conditions utilizing the reserve of rolling stock, that the purchase of new freight cars would see the gradual introduction of roller bearings in freight service.

Freight-car roller-bearing development has involved the construction, testing, and arrangement for operation of equipment in capacities of 40, 50, 70 and 100 tons. These cars were built singly or in groups of two or three to develop the characteristics of specific constructions. The solution of the problem incident to design and construction of the bearings and the modification of freight equipment more effectively to receive the bearings, was followed by the construction and test of 100 sets of roller-bearing trucks of a capacity to carry 70-ton hopper bodies.

The 100-car train has been tested in service a total of 3,000,000 car-miles, and as complete trains or in single cars has been tested under the following conditions, in comparison with plain-bearing cars of identical capacity: Running-resistance tests, summer conditions, empty and loaded; running-resistance tests, winter conditions, empty and loaded; above conditions starting cold, and above conditions after obtaining equilibrium temperature; starting tests, with complete trains; starting tests, with single cars; acceleration tests with complete trains, and tonnage-rating tests with complete trains.

The data, as regards running tests and starting tests of single cars in addition to the accumulated service of the 100 cars over a period of three years, permit of drawing reasonable deductions as to the value of roller-bearing equipment in railroad service. Freight-service improvement by roller bearings, from the data derived from the tests, supplemented by service records, can be listed under the following headings:

1—The break-away resistance of the roller-bearing cars, as developed in 115 tests, was slightly in excess of the low-speed rolling resistance, as compared with the break-away resistance of the plain-bearing cars, which is ten or more times the lowest rolling resistances. This characteristic should be reflected in reduction of wear and tear in couplers, draft gear and car bodies, and in reducing the strain on locomotives in starting.

2—The running-resistance tests indicate a reduction in rolling resistance of the roller bearing throughout the entire speed range. The reduction is considerable in starting cold trains, amounting to approximately 40 per cent, notwithstanding the variety of starting characteristics in freight equipment due to slack in couplers and draft gears.

A reduction of 16 in 26 per cent, varying with weather conditions, is indicated after ten miles' operation.

The reduction at the equilibrium point, attained after approximately 20 miles' running where the temperature of the plain bearing ceases to rise, averages 11 per cent.

Equilibrium tests with loaded cars is the best indication available of the comparative rolling resistance of cars with the two types of bearings. A general reduction with the roller bearing, ranges from 13 per cent at 10 m.p.h. to 9 per cent at 45 m.p.h.

The test data and the experience available with roller bearings indicate a wide divergence at starting and the comparable rolling resistance of the plain and roller bearings converge at approximately 25 m.p.h., with parallel curves above that speed. The data available in the comparison of plain and roller bearings in steel-mill service indicate greater divergence and more important economies while other data available for higher speeds and heavy loads, available in the copper-rolling industry, indicate still further economies in favor of the roller bearing.

3—Tonnage ratings, as between winter and summer service, can be made uniform with roller bearings.

4—Acceleration tests, while limited in number, furnished indications that roller-bearing trains can be accelerated to pre-determined speeds in less time or with less power, and given the same power will attain a certain speed in a shorter distance. Curves show acceleration tests are shown in the chart. These tests showed a temperature rise in attaining a speed of 25½ m.p.h. for the roller bearing of zero, whereas the temperature rise of the plain bearing in attaining a speed of 24 m.p.h. is 54 deg.

5—Starting tests with complete trains, made in limited numbers, gave indications that trains of equal weight can be started with plain or roller bearings with trains having full slack on a .3 per cent grade.

The increase in the size of the stretched train that could be started with identical locomotives on roller bearings was 76 per cent. A total of 76 cars were started with either type of bearing in a slack train, but with a stretched train 65 roller-bearing cars and 37 plain-bearing cars developed the full capacity of the identical locomotive. In fairness, it should be stated that the starting tests with complete trains were made after roller-bearing cars had made an average of 1,500 miles' service. The run-in condition of the roller bearings, as indicated by a 10-per cent lower rolling resist-

ance after running 6,800 miles, indicate that a more favorable showing, as regards the roller bearing, would have been made if the tests had been deferred to the latter part of the program.

Elimination of Hot Boxes—Reduced Maintenance

6—Hot boxes, based on experience from October, 1925, on the first cars built, and including the experience of the 100-car roller-bearing train, indicate that hot boxes are eliminated as a factor in railroad operation by the roller bearing. There have been no hot boxes to date.

7—Reduction in car maintenance is indicated by the experience with the 100 cars, with over 3,000,000 car-miles without repairs to bearings or related parts and without a recorded repair to car bodies. While the experience is limited a reduction in maintenance with roller bearings is indicated.

8—Increased speed of transportation should result with the use of roller bearings. Speed limitations, as imposed by plain bearings, are eliminated entirely. It was found that 50 m.p.h. was the maximum permitted speed of the loaded 70-ton equipment as used in the running tests. The roller-bearing cars were operated at the top speed of the freight locomotive; namely, 66 m.p.h., without appreciable heat rise, but the plain-bearing cars developed hot boxes with such frequency at speeds of 50 m.p.h. as to cause the abandonment of the test program with plain bearings at the higher speeds. Higher speeds than 50 m.p.h. are operated on plain bearings in passenger service and in general freight commodity service, but with reduced axle loads. It is expected that increased truck competition will force higher railroad speeds.

9—Improved reliability of service is indicated by the experience with tapered roller bearings on one road of over 47,000,000 miles without a train detention chargeable to roller bearings.

10—Economy in fuel should follow the reduction in rolling friction throughout the entire speed range, from 5 to 50 m.p.h. An economy of 10 per cent on level track would be equivalent to a 3 per cent saving on a normal heavy tonnage grade of .3 per cent and would be equivalent to 1½ per cent on a 1-per cent grade. Fuel saving is effected by many other variables, but a general average could be expected.

11—Improvement in coupler and draft-gear service should follow the use of roller bearings on account of the 90-per cent reduction in effort required in breakaway and the 75-per cent reduction in starting a stretched train. It is recognized that the roller bearing will not affect favorably the damage to draft gears in coupling in yard service, or in violent surges throughout a train on account of the topography of the track, but the wear and tear resulting from starting of heavy trains would undoubtedly be reduced. A noticeable improvement in passenger-train operation on roller bearings, as regards smoothness of running, furnishes an indication of the possibilities in freight operation.

Economies in Freight Train Operation

12—An increased capacity of locomotives to haul larger trains or to haul equivalent trains at faster speeds is a national corollary of the reduction of rolling friction. An important factor is that the low-rolling frictional characteristics of the roller bearing are available when needed most, namely, in starting cold trains and in operation over yard tracks generally not maintained to normal road standards when, on account of fire and bearing conditions, the locomotive is not operating at full capacity.

13—Helper service under certain limited conditions would be eliminated. An example would be starting cold trains against adverse grades and in starting under unfavorable weather conditions.

14—Year-around lubrication without change, as regards summer and winter oils, is available with the roller bearing. The freight-car experience is limited, but the experience in locomotives and passenger cars indicates an important economy in lubricating costs.

15—Life of car axles will be increased with the use of roller bearings. This is due to the absence of wear on the journals, absence of fillet wear and the elimination of heat checks.

16—Transportation expenses would be affected favorably by the roller bearing in providing for operation over several divisions at higher sustained speeds without attention for bearing inspection or maintenance.

17—Low-speed stalling would be reduced by the straight-line characteristics of the roller bearing. The friction at zero speed being only slightly above that at 5 m.p.h. Observation indicates that plain-bearing trains almost invariably stall when, due to grade conditions, speed is reduced below 5 m.p.h., whereas the roller bearing would not be subject to increased rolling friction following the breaking down of oil film at low speeds. This factor, however, will be more fully determined when funds are available to test trains at speeds from ¼ to 5 m.p.h.

Timken Inboard Truck

The Timken inboard truck was used on the 100-car tests. The distinguishing characteristics in the inboard mounting of the bearings and the elimination of any truck mechanisms projecting beyond the wheel hub.

The weight reduction is a factor of importance, amounting to 4,400 lb. per 70-ton car.

A reduction in rail blow due to car bodies rocking is an important characteristic of the inboard truck. This follows the elimination of uncontrolled lateral freedom within the bearing. The swaying of the car body is, therefore, resisted by the springs. The unrestrained movement through a moving plain bearing, with lateral freedom varying from ½ in to 1½ in., which develops rail blows in proportion to the lateral distance travelled, is reduced.

Rail-blow tests were made on several combinations of springs and loads on inboard and outboard trucks. Test facilities were provided to show a continuous record of spring deflection showing oscillations synchronized with rail joints and showing also spring movement with either wheel speed for rail joints. The characteristics of the inboard and outboard truck, as regards percentage of dynamic increment over static rail load, of the inboard trucks with a ring spring vary from 12.9 to 23.1 per cent. The inboard truck percentage of dynamic increment without the ring spring varied from 24.6 to 28.1 per cent. The outboard-bearing cars developed a percentage of dynamic increment with the ring spring of 29.2 per cent and without the ring spring, from 29.2 per cent to 51.2 per cent.

The inboard car with 100 tons of coal developed dynamic rail loads per truck side of 71,942 lb., with the standard spring suspension of five A.R.A. double coils and one ring spring, whereas the dynamic rail load of the outboard trucks with 78 tons of coal and medium box lateral of 1¼ in. was 71,124 lb. These figures are comparable as they represent the average bearing wear of the plain bearing and normal roller-bearing spring equipment.

This test indicates that the Timken inboard car carries 100 tons of coal with the same dynamic rail load

per truck side as is regularly experienced on plain-bearing outboard cars carrying 78 tons of coal. This statement is further corroborated by the Timken 100-ton inboard car in transporting 10,000 tons of coal between the Ohio River mines and Canton, Ohio, without requiring any repairs to body, draft gear, couplers, wheels or truck parts.

Tank Car for Handling Dry Bulk Commodities

THE General American Tank Car Corporation has recently developed the "Dry-Flo" tank car, designed to handle such dry, bulk commodities as cement, lime, silica sands, sulphur, fertilizers, soda ash, potter's clays, Fuller's earth, etc. Several months' experience with a number of these cars in actual service indicate that they possess the combined advantage of moisture-proof shipment, automatic, dustless loading and unloading, simplified collecting and conveying equipment at plants, elimination of packaging expense and the saving of at least two manual handling operations.

The "Dry-Flo" tank car is simple in operation, loading being accomplished by the connection of suitable conveying pipes to any one of six small manways located at the top centerline of the tank. The car is unloaded by means of two drag-chain conveyors within the tank which draw the lading from each end toward the center discharge opening. The chains move along

Dustless unloading is provided at a single small center hopper

the bottom of the tank toward the center, continuing upward and back along the top to the ends where they operate over sprockets arranged for easy inspection when necessary. The driving mechanism is housed in a small center compartment communicating with the dome.

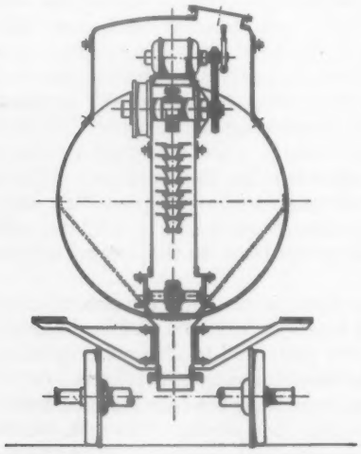
Details of the Mechanical Unloading Mechanism

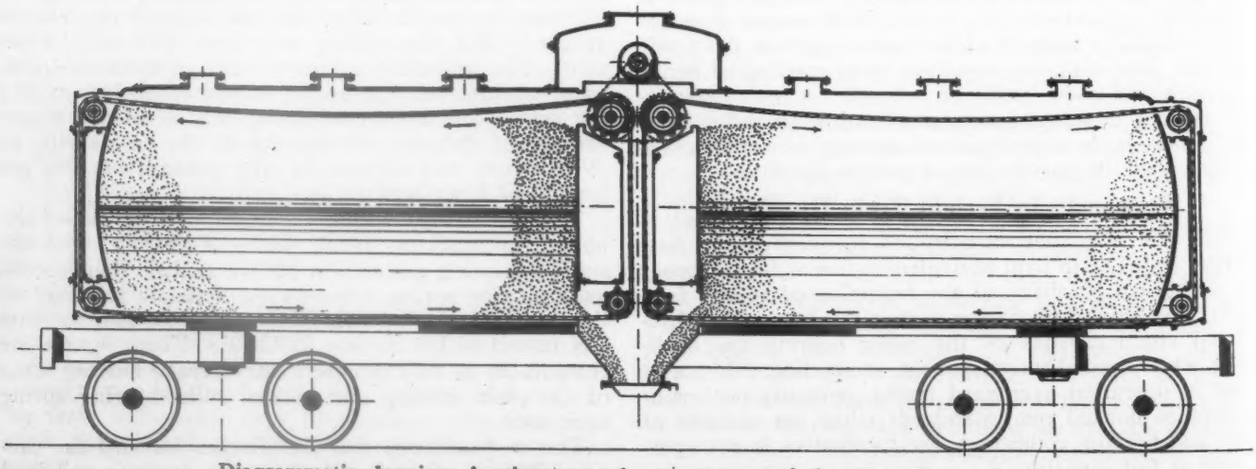
Power is furnished by an electric motor located within the dome, or by means of external power which may be applied to a shaft provided. An interesting gear reduction having a high ratio is used, making it possible to secure a low speed for the conveyor chains. Provision is made for throwing out power on one end of the car, should it be desired to unload at a lower rate of speed, and also for the purpose of starting one end at a time, should the lading be unduly packed or frozen. The only requirements in starting the unloading operation is to open the slide valve at the hopper outlet and plug in a flexible cable connection from the motor to a source of electric power, either 220 or 440 volts.

Two bulkheads placed in the center of the tank

Principal Dimensions of the Dry-Flo Tank Car

Length over striking castings	47 ft. 2½ in.
Length over tank shell	40 ft.
Inside diameter of tank	96 in.
Height from rail to loading manways	12 ft. 1 in.
Height from rail to dome	14 ft. 6 in.
Height from rail to bottom outlet	1 ft. 7 in.
Net capacity for lading	1,600 cu. ft.
Discharge rate, one end	400 cu. ft. per hr.
Discharge rate, both ends	800 cu. ft. per hr.
Truck capacity	50 tons or 70 tons



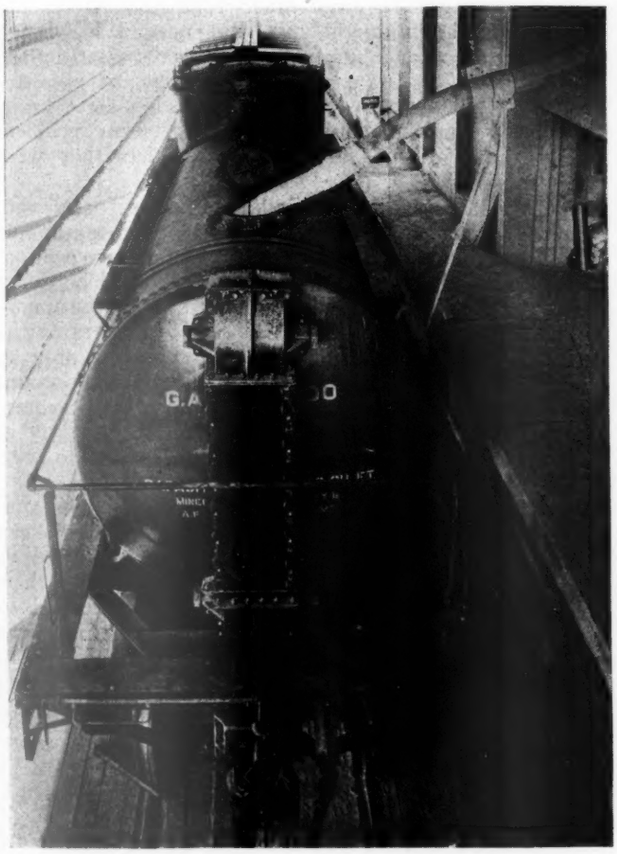


Diagrammatic drawing showing general arrangement of the "Dry-Flo" tank car

under the dome provide the entirely-enclosed dust-proof compartment for the driving mechanism. Power is transmitted from a 1,200-r.p.m. ball-bearing electric motor to one right-hand and one left-hand special "Heliocentric" speed reducer by a heavy-duty, double-roller chain. The electrical current characteristics are arranged to suit the customer's requirements. A "Twin Disc" friction clutch is placed between the motor and speed reducers to facilitate starting and stopping.

The Heliocentric speed reducers are the entirely closed type, running in oil. The conveying chains are driven by sprockets directly on the speed-reducer shafts. All bearings are Alemite lubricated and are so designed as to be dust-proof and oil-tight.

A heavy, special, endless drag chain, 14 in. wide and



Loading at a cement manufacturing plant

operating at the low speed of 10 ft. per min., is provided for each compartment. Slope sheets along the sides of the tank divert the commodity into the path of the chain so that it is conveyed into the discharge hopper. The driving mechanism is arranged to drive one or both chains, thus providing the two-speed discharge rate referred to.

The car may generally be unloaded in less than two hours, varying slightly according to the commodity. This provides a discharge rate of about 400 cu. ft. per hr., using one chain, or 800 cu. ft. per hr., using both chains. The discharge is arranged to empty the car completely.

Standard Tank-Car Construction Followed

The "Dry-Flo" tank car conforms to the general standards of tank-car construction and is designed to meet all American Railway Association requirements. It is equipped with the latest type of GATX standard trucks complete with cast-steel side frames and truck bolsters, Barber lateral-motion device, adjustable roller side bearings and Schaefer brake equipment. The truck capacity is 50 to 70 tons, according to commodity.

The underframe is of the GATX Type-30 standard tank-car construction, complete with Westinghouse air-brake and power-type hand brake. The tank is anchored to the underframe by a double, tank-car type anchor located near the center of the car. The tank is supported at the body bolsters according to the best tank-car practice. The tank is further anchored to the underframe by two tank bands at each bolster.

The tank is of four-plate construction, with a standard tank head at each end. The dome at the center, providing a housing for the motor and other conveying machinery, is equipped with hinged covers to allow access to the machinery for motor connection and clutch operation. All seams are securely riveted to provide absolutely water- and dust-proof construction.

Six water-tight and dust-proof loading manways are provided at the top of the tank so that it may be loaded to its full capacity without pyramiding of the commodity. Many commodities, such as cement, may be loaded through oneman way, only, at each end. The manways, 16 in. in diameter, are equipped with gasketed, bolted and hinged covers.

FOLLOWING COMPETITIVE EXAMINATIONS conducted by the College Entrance Examination Board for the Pennsylvania Railroad, two Frank Thomson memorial scholarships, each worth $800 annually, have been awarded to sons of P.R.R. employees. The successful contestants were Alfred C. Roberts, son of A. P. Roberts, clerk in the secretary's department at Philadelphia, and Charles H. Campbell, son of C. H. Campbell, chief draftsman at Logansport, Ind.

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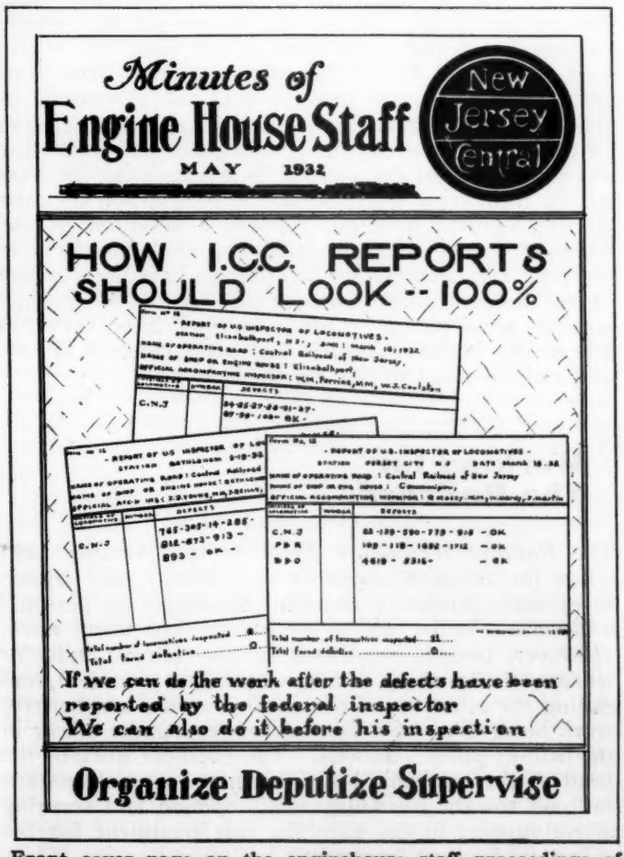

Minutes of
Engine House Staff
MAY 1932
New Jersey Central
HOW I.C.C. REPORTS SHOULD LOOK -- 100%
If we can do the work after the defects have been reported by the federal inspector We can also do it before his inspection
Organize Deputize Supervise

Front cover page on the enginehouse staff proceedings of the New Jersey Central

EDITORIALS

Pilot Height And Crossing Accidents

Although the elimination of grade crossings has been continuing at a rapid rate (usually at the expense of other and more important improvements) nevertheless there are many grade crossings still in existence at which accidents are liable to occur. On one road collisions with highway vehicles caused a number of serious derailments owing to the fact that some heavy part of the automobile or truck got under the pilot and raised the front of the locomotive, thus causing the locomotive to leave the rails and sometimes turn over.

The law requires that pilots be maintained not less than three inches and not more than six inches from the rail. Following an investigation of a number of grade-crossing accidents, the mechanical department adopted a rule that all locomotive pilots be maintained at four inches, no more and no less.

The standard pilots applied to the locomotive of the road in question are built up with 3-in. by 3-in. by ½-in. angles and 4-in. by ⅞-in. bars, and scrap boiler tubes are used for the pilot bars. In addition, the front of the pilot is securely braced to the coupler pocket by a vertical V-shaped leg, which extends from the nose of the pilot up to the bottom of the pocket. This brace is of 3-in. by ⅞-in. bar and prevents the nose of the pilot from sagging. When striking an obstruction, such as an automobile across the track, this brace throws the obstacle over to one side of the pilot which, in turn, forces the obstruction off the track.

It was found that if the pilot was more than four inches above the rail, some part of the automobile or truck would get under the pilot or raise it and the front of the engine, thus causing a derailment and increasing the seriousness of the accident by endangering the lives of the train crew and passengers, in addition to those in the highway vehicle. Since the adoption of the "four-inch rule," which is rigidly enforced, and the present pilot arrangement, no derailments have been caused by collision with highway vehicles. On the other hand, several accidents at grade crossings have occurred where the highway vehicle has been sheared in two and thrown clear of the track.

Working for The Railroads

The *Railway Mechanical Engineer* has in times past, when the occasion appeared to warrant, paid tribute to or made laudatory comment editorially on personal achievement in the field of mechanical-department work. However, present conditions in the railroad industry warrant the breaking of long established precedent, and calling the attention of our readers to the constructive work being done by a mechanical-department officer in the field of public relations. The excellent work of the head of the mechanical department of a small eastern railroad toward moulding public opinion and securing active support in the fight for fair treatment for the railroads deserves comment.

This mechanical-department officer is the founder and president of the Railroad Employees' and Tax Payers' Association of his state. He is active in the organization of similar associations in other states. A large part of the expense incurred in this work for the railroad industry has come out of his own pocket. His prestige and influence have grown to such an extent during the past two years that his views on the railroad question are frequently sought by governors of states and congressmen.

This work has required much time and effort, and burning of the midnight oil. But needed legislation regulating truck and bus traffic has been passed by the legislature of his state and other important bills are pending. Furthermore, the people of his state know considerably more about the transportation problem and are better friends of the railroads than they were two years ago.

We are not advocating similar activities for all mechanical-department officers. The majority are not able to devote the time and effort to such an avocation. But we wish there were 47 others who could be doing similar jobs in each of the 47 other states of the union.

The experience of this officer clearly illustrates the fact that political results can be accomplished only by political methods. What weighs heaviest in the councils of state is *votes*. A minority organization of voters who know what they want and are willing to stand—and vote—together to get it is always listened to with respect.

But organizations do not spring into being spontaneously. It takes leadership to get them going and keep them going. If any of our readers are interested in the development of similar groups, who will exert their political influence to secure the legislation needed to give the railroads an even break in competing with other transportation agencies, we shall be glad to supply them with useful information as to what others are doing and how they may best approach their objectives.

Why Quit with Victory in Sight?

September opens the 1932-1933 season for the various railroad clubs and associations which meet each month in cities all over the country and Canada. About a dozen of these organizations of railroad and railway-supply men are located in large centers of population, each one of which serves a considerable territory, and are important focal points for developing and serving the common interests of all men in these two related industries.

Most of these clubs have suffered a loss in membership and an even greater reduction in revenues. In many instances the club treasury has become sadly depleted and the problem of how to continue operation has become more and more difficult of solution. For that reason, several important clubs and associations have suspended operation "until business picks up."

Contrary to the expectation of many railway-club workers, the 1931-1932 season was marked by greater interest in the programs and by increased attendance. The New York Railroad Club probably broke all pre-

vious records for attendance and most of the other clubs reported good attendance records for the past season. From the standpoint of attendance and quality of programs the 1931-1932 season was undoubtedly one of the most successful of many years.

The local railroad clubs and associations have been performing an important function in the industry. They have not only afforded an opportunity to interchange ideas and serve as a forum for the discussion of important railway-industrial problems, but they have also served to weld men with common interests together for united effort.

The railroad industry is in the midst of an extremely important battle—a fight for its right to live on terms of equality with all other forms of transportation. Right now the fight is hottest, and now is no time to disband or suspend what might be important units of our fighting forces. It is to be hoped that no more of these clubs will find it impossible to continue, even if it is necessary temporarily to curtail some of the social activities which call for relatively heavy expenditures.

Car Wheels

The average layman little realizes how much of inventive genius, patient research, exhaustive service tests and resolute determination to achieve the maximum adaptation of materials to human needs enters into the construction of the "common" car wheel. Even in 1931, a year of severe depression in which the wheels of industry seemed hardly to turn, 1.6 billion revenue tons of freight were transported on Class I railroads. The safe and efficient handling of this vast amount of material would have been absolutely impossible without the modern car wheel, as developed to its present high standard of efficiency by the combined effort of the railways and car-wheel manufacturers after years of intensive study and development.

A review of the proceedings of the American Railway Association, Mechanical Division, and its predecessors, the Master Mechanics' and Master Car Builders' Associations, indicates that the cast-iron car wheel was adopted as recommended practice in 1893, almost 40 years ago. Revisions of the original design were made in nine subsequent years up to 1920, when the designs of the two parent associations were harmonized by the Mechanical Division into a single recommended practice, which has since been revised in certain details four times, up to and including the year 1932. These specifications, which cover all 33-in. cast-iron wheels for railway service, for loads of maximum gross weight up to 210,000 lb. (8 wheels), were developed as the result of continuous research and tests covering design, chemical composition, foundry practice, mounting practice and service conditions. During this development, many varying chemical compositions were tried and many changes in foundry practice made, the performance of thousands of test wheels being observed in service, or the wheels broken on a drop-test machine and the physical and chemical properties studied in the laboratory. Every wheel which breaks in service is subject to still further study and research in an effort to effect still further improvement in cast-iron wheels. The Mechanical Division Committee on Wheels has frequently expressed its appreciation for the valuable co-operation and assistance rendered by the Association of Manufacturers of Chilled-Iron Car Wheels which maintains a laboratory at Chicago and a staff of expert engineers and chemists whose sole attention is devoted to research in connection with this subject.

Solid wrought carbon-steel wheels, first developed about 25 years ago, have also played an important part in the transportation service rendered by the railroads. These wheels were not adopted as recommended practice until 1912. They were advanced to standard in 1917, and subsequently revised five times up to 1926, the specifications covering all solid wrought carbon-steel wheels for locomotives and cars. The use of this type of wheel introduced many new problems which required solution, and the Committee on Wheels, in co-operation with the Technical Committee on Wheels of the Association of American Steel Manufacturers, has been actively engaged in intensive research in this subject. Thousands of solid wrought-steel wheels, also, have been subjected to exhaustive test both in the laboratory and in service, with a view to perfecting this type of wheel and thus promoting greater safety and economy in railroad operation. One of the important recommendations in the last report of the Committee on Wheels was for the elimination of the secondary chamfer and the substitution of a single standard tread and flange contour for all wrought-steel and steel-tired wheels, thus providing not only an improved wheel design, which should give longer and more reliable service, but also reducing the number of gages and turning tools required.

The performance of car wheels has such a vital relation to the safety and efficiency of railway service that it would be difficult to overemphasize the value of services rendered by those earnest and able railway officers and manufacturers through whose initiative, courage and perseverance the modern car wheel has been brought to its present high state of development. It has been estimated that a railroad system owning 80,000 cars normally spends over $2,000,000 a year for wheels and labor in connection with wheels.

Controlling A Major Expense

Locomotive repairs constitute the largest single railway operating expense account. In 1929 the expenditures in this account exceeded by almost a fifth the combined amounts spent for fuel and electric power for all locomotives, both yard and road. It exceeded by a quarter the wages of the enginemen required to operate the locomotives in both yard and road service. The combined accounts covering the wages of road trainmen and of yard conductors and brakemen are greater than the cost of locomotive repairs, but by less than three per cent.

On another page in this issue is an account of the study of the cost of locomotive maintenance per ten-thousand horsepower-miles—potential boiler horsepower being the basis of comparison to take into account the effect of the varying capacity of individual locomotives. This study, undertaken by the Baldwin Locomotive Works, has disclosed a trend of repair costs with respect to age which is bound to be of great significance with respect to future motive-power policies. A study of several thousand locomotives, owned by several railroads, has disclosed an apparently universal increase in the cost of locomotive repairs with increasing age. The data indicate that, roughly, the annual cost doubles during the first three years after the purchase of the new locomotive and then again doubles within the next twenty to twenty-two years.

In studies to determine the financial justification for the purchase of new motive power, the effect on maintenance costs per unit of service of the replacement of old motive power with new has usually been considered as an indeterminate factor. The other operating savings have to bear the entire burden of justifying the investment in the new power. A reduction in the cost of maintenance alone which, according to the results of the Baldwin study, would amount to about $5,000 a year by the replacement of a 22-year-old, 2,200-hp. locomotive by a new one in kind, becomes a matter of major importance in any motive-power study.

The significance of this steady increase in the cost of repairs with advancing age will, of course, be greatest in considering ways and means for replacing obsolete motive power with modern high-capacity units in heavy main-line service. It has a bearing on another situation, however, which has seldom received adequate attention. That is the provision of locomotives for secondary services which are specifically proportioned to meet the requirements of such services.

For years there has been a definite tendency to increase the capacity of the new locomotives purchased for main-line freight service where the movement is in heavy volume. This has made it constantly more difficult to fit the locomotives replaced on the main lines to the needs of the secondary lines. Because there is nothing else for them to do, many such locomotives are operating where units with less weight on drivers and horsepower capacity would better fit the conditions.

The Baldwin study suggests two facts concerning such power which may ultimately lead to a better balance of the motive power and the requirements in secondary services. First is the costly maintenance due to advanced age and, second, the additional cost of maintaining capacity in excess of the needs. If, for instance, a 2,200-hp. locomotive 22 years old has been set back on a line where the demands of the service and the lack of traffic volume do not permit train operation beyond the capacity of an 1,800-hp. unit, the maintenance cost of the old locomotive, assuming an annual mileage of, say, 30,000, will be in the neighborhood of $10,000 a year. If this were to be replaced in kind by a new locomotive, the cost of maintenance would be about $5,000 less. But if the old locomotive were replaced by a smaller one proportioned for the job, the cost of maintenance per locomotive per year, performing the same service, might be $5,700 less. Taking into account fuel savings resulting from modern thermal efficiency and the better load factor, such a locomotive would effect a gross return close to 15 per cent in the investment from these two accounts alone. If conditions permitted the full utilization suggested by the flexibility of such a unit, the return might be considerably greater.

No doubt, operating the new locomotive at an increased load factor as compared with the old one may somewhat reduce the difference in the unit cost of maintenance as here set forth. But this reduction will be small; the cost per locomotive-mile is largely controlled by the capacity of the locomotive and affected to a lesser degree by differences in the per cent of potential capacity actually realized while the locomotive is in service. Considered as a whole, the example hardly represents an extreme case of operating excess locomotive capacity.

Locomotive repairs is the largest single railway operating expense account. The Baldwin study indicates that it is definitely controllable by control of the age of the locomotive inventory. The average age of the locomotives owned cannot be controlled forever by buying power only for main-line mass transportation and never retiring the power which can be run on secondary lines. The possibilities for economy and improvement in the quality of the service on lines with relatively small traffic volume, warrant careful investigation.

NEW BOOKS

THE MOTION OF RAILROAD VEHICLES ON A CURVED LINE. *By C. F. Dendy Marshall. Published by The Railway Engineer, 33 Tothill street, Westminster, London, S. W. 1. 41 pages, 9 in. by 12 in. Bound in cloth. Price 12s, net*

The author of this book, C. F. Dendy Marshall, is well known for his previous book, "The Resistance of Express Trains." He has also contributed many articles on railroad subjects to the Railway Engineer and other British publications. In this book, The Motion of Railway Vehicles on a Curved Line, he has undertaken to analyze the behavior of the wheels of a 4-6-0 type locomotive, a type which is gradually becoming little used on this continent, and has discussed the merits and demerits of various forms of engine trucks, radial axles, etc. Considering the wealth of material available on the subject, Mr. Mashall's book is a disappointment. In making this criticism we have in mind the thorough studies made by R. Eksergian, the results of which were published in a paper before the American Society of Mechanical Engineers, and investigations of the Chicago, Milwaukee, St. Paul & Pacific and the Bessemer & Lake Erie. Mr. Marshall's book is divided into eight chapters and an appendix. The titles of these chapters are as follows: Historical Sketch of the Methods by which the Problem Has Been Attacked; A General Consideration of Motion on Curves; The Equations for a Locomotive; The Limiting Positions of the Engine Wheels; The Mean Paths; Radial Axle Boxes and Pony Trucks; Possible Lines of Improvement in Bogies, and The Geometry of Carriage Bogies. The appendix covers the curving of road vehicles.

DIE ENTZUNDUNG UND VERBRENNUNG VON GAS-UND BRENNSTOFF-DAMPF-GEMISCHEN *(The Ignition and Combustion of Gas and Vaporized Fuel Mixtures). By Dr. W. Lindner Published by Verein Deutscher Ingenieure, Berlin, Germany. 85 pages, illustratea. Price, paper cover, 7.50 reich marks.*

The action of thermal energy in the cylinders of internal-combustion engines which has offered numerous difficulties to the fundamental sciences, such as physics and chemistry, is explained in this book by Dr. Lindner, which is written in German. The author coordinates known physical and chemical properties which can serve in the explanation of the occurrences in gas and vaporized fuel mixtures and includes the events taking place in the open flames of burners, as well as the expulsion phenomena in closed vessels and internal-combustion engines. The chemical reactions in the combustion of hydrogen, carbon monoxide and hydrocarbon mixtures, as ascertained by spectroscopic flame analysis, are described, and the concentration of the real velocity of ignition in the propagation of combustion is pointed out. Modern thought regarding the procedure of reaction is correlated, and a critical review of the known methods for determining the velocity of ignition is followed by reports on experiments concerning the factors by which the velocity of ignition is influenced. Ignition by electric spark is also considered, both as an electrical or a purely thermal process. Knocking is dealt with in a special chapter, the problem being considered both from the chemical and the gas-dynamic viewpoints.

THE READER'S PAGE

It's Little Things That Count

TO THE EDITOR:

Frequently in attempting to solve the larger problems pertaining to the operation of the mechanical department of a railroad, we overlook the little details. As I read your editorial pages I sometimes wonder if the editorial staff of the *Railway Mechanical Engineer* is not also guilty of the offense of overlooking many of the small items which added together cost the railroad real money.

I would like to illustrate my point by telling the following instance. Several years ago the writer and a number of others made an investigation of the steam consumption from the shop power plant at a large divisional point on this railroad. This plant supplied a heavy electric power load to the shops and in addition there were miles of transportation yard lighting besides office buildings, a large Y. M. C. A. building, a hospital and station. It also furnished steam power to a boiler-washing plant, a large car yard, back shop, coach shop, planing mill, dry kiln, enginehouse and passenger transfer track. Furthermore, it furnished all the service water and drinking water and operated three air compressors of approximately 7,000 cu. ft. capacity.

These tests were authorized after a great many complaints to the effect that the boiler capacity of the plant was over-taxed. It was considered necessary to purchase a new boiler unit to take care of the increasing demand. As a result of this investigation authority was requested for the purchase of a new 400-hp. boiler unit.

Business conditions at that time did not permit this expenditure. Therefore, the shop superintendent had a check made for steam leaks of all the piping and fittings. He also issued instructions to cover all bare pipe and to dig up all underground piping wherever possible and place it in conduits. A check was made of the various appliances, steam traps, radiators, and other devices attached to the steam lines. A flow meter was installed in the line leading into the dry kiln, the recording thermometer was overhauled and made accurate, efficient traps were provided and improved methods of charging and discharging were installed. In the shop buildings many lengths of pipe were removed from obsolete locations, many square feet of radiator surface eliminated and a considerable number of unnecessary steam consuming devices located at many places around the shop were abolished.

There was such a noticeable difference in the steam consumption after this work was completed that it was further decided to check all electrical appliances, light fixtures and drops. In this investigation a number of small unimportant offices were eliminated as well as many 50-watt droplights and outside lights. With the completion of this investigation nearly 1,000 large electric light bulbs were returned to stock and several miles of wire ranging in size from No. 4 to 14 was cut out.

As an example of some of the inconsistencies which had been existing for years we found one office, 8 ft. by 10 ft. floor space, which had five 100-watt ceiling lights set into 12-in. glass reflectors and then the stenographer also had a 75-watt portable lamp over her typewriter.

In such cases, the fixtures were simply cut loose to prevent their further use. It was found that by placing switches at strategic points some lines could be cut out entirely and others sealed against use except by authorized persons. New lamp installations were made at several places where needed.

The moral of this story is that by correcting the numerous small offenses which had been costing the company good money over a long period of years we were able to save the cost of purchasing and installing a new boiler unit.

W. L. McGOWAN.

Proves Ripley Is Wrong

TO THE EDITOR:

In the June, 1932, issue there appeared a letter from a reader under the caption "Believe It or Not" relative to an explanation by Mr. Ripley on how ten cents will stop a locomotive.

The following is taken from the Southern Pacific Bulletin of the Texas and Louisiana Lines, from which you will see, according to the test made, that Mr. Ripley under-estimated Southern Pacific locomotives.

"Some time ago Ripley presented a statement with one of his famous cartoons to the effect that ten cents will stop the most powerful locomotive made. His theory was to place one penny under each of the ten wheels of these great engines, which would prevent the locomotive from starting because it would necessitate it lifting its entire weight. This, he said, would keep it from developing sufficient motive power to make the start.

"A newspaper reporter on the Dallas Times-Herald doubted Mr. Ripley's theory. He obtained the services of W. F. Rentzel, traveling engineer on the Dallas division, and W. H. Moore, mechanical superintendent of the Dallas Union Terminals company. Then they had a 600-type engine, under steam, brought to the Terminals station, and there before a large crowd of curious people placed the ten pennies under the driving wheels of the locomotive.

"Engine 623, which underwent the test, proudly lifted its 281,000-lb. bulk, with its 572,000-lb. filled fuel tank, on top of the ten perfectly good pennies, and immediately dispelled Mr. Ripley's theory. The badly smashed pennies were given to the Dallas Kiwanis Club to be placed in the containers now being used to collect money for the unemployed.

"Mr. Ripley has been advised that he will have to spring another one unless he wants to use other than Southern Pacific locomotives.

"Robert L. Ripley, whose 'Believe It or Not' cartoons appearing in numerous leading newspapers and other publications have made him renowned the world over, has missed his calculations. He simply doesn't know Southern Pacific locomotives."

Your question, How about it? I don't know, but the proof of a pudding lies in the eating.

A READER.

With the Car Foremen and Inspectors

Motorized Narrow-Gage Delivery System Improved

A DESCRIPTION of the motorized narrow-gage material-delivery system for car-repair yards, now generally approved as standard on the Chicago & North Western, was published beginning on page 32 of the *Railway Mechanical Engineer* for January, 1931. Since the preparation of this article, a number of important improvements have been made which greatly increase the value of the system from a material-handling standpoint.

For example, in the motor unit, the Model-A Ford gasoline engine has been set forward on the front truck, tests having proved that this facilitates movement of the machine, particularly when going around curves. The width of the machine has been reduced slightly in order to provide as much clearance as possible, but the length of the material box on the rear has been increased to 54 in., giving greater capacity. The sides of the material box are hinged and readily dropped to facilitate handling truck sides and similar large material as shown in one of the illustrations.

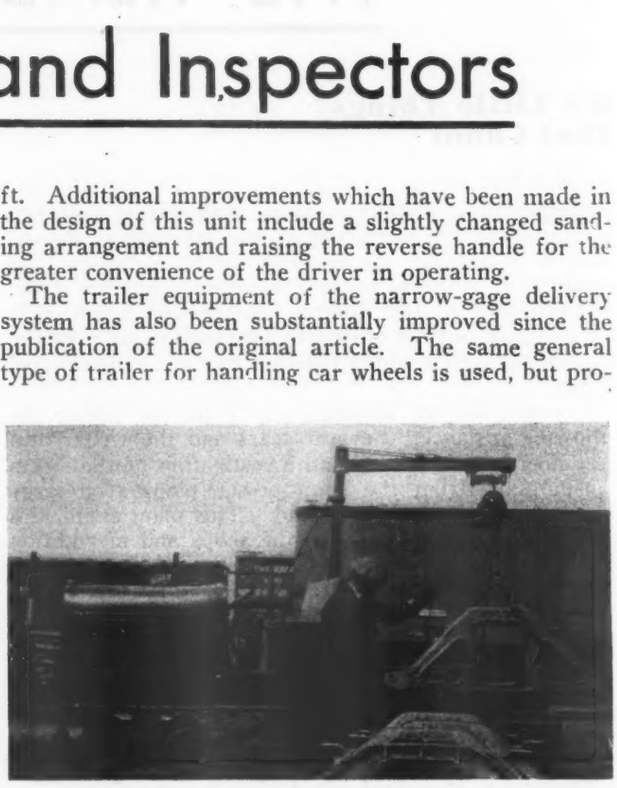
One of the most important changes in the motor unit has been the addition of the gib-crane which has a swing of 53 in. and a lift of 46 in. above the material-box floor. Equipped with a one-half ton chain hoist, this crane permits one man to load and unload the heaviest materials used in car-repair work, such as truck sides, truck and body bolsters, etc. The boom of the

Narrow-gage wheel trailer which can also be used with transoms in units of two for transporting lumber

crane is of box section to enclose and completely protect from the weather the four-wheel traveling dolley, which supports the chain hoist. The boom swings on a double roller-bearing housing and is stiffened by two diagonal rods and turnbuckles. The mast is bolted securely to the motor-car body, being held rigidly in a vertical position by three tie rods.

This motor unit is equipped with roller bearings throughout to permit ease of operation and low fuel consumption. The four-wheel leading truck design permits readily negotiating curves with a radius as short as 17 ft. Additional improvements which have been made in the design of this unit include a slightly changed sanding arrangement and raising the reverse handle for the greater convenience of the driver in operating.

The trailer equipment of the narrow-gage delivery system has also been substantially improved since the publication of the original article. The same general type of trailer for handling car wheels is used, but pro-



Motor unit equipped with crane and material box having drop sides

vision is made for the insertion of a steel transom with vertical side extensions for use when this trailer is employed in the transportation of car sills and other long lumber. The center pin of the transom is simply inserted in a center hole provided in the trailer frame, and by using two trailers any length of timber can be handled. Referring to the illustration, it will be observed that in the handling of car wheels the wheels are simply rolled on to the trailer in a position lengthwise of the track, being supported on the axle at two points just inside the wheels.

The combination three-in-one car is a convenient piece of equipment in practically constant use. Equipped with roller bearings for easy movement, it can be used as a high-side gondola for the movement of scrap, wood, or other material; the hinged top boards can be dropped making a low-side gondola for handling bolts, nuts, etc., or the sides can be removed entirely and the unit used as a flat car for the hauling of lumber. This car, with sides built of 2-in. and 1½-in. oak, is slightly over 7 ft. long and the box 3 ft. 3 in. wide by 2 ft. 6 in. high. It has a capacity for 4,000 lb. and a light weight of 800 lb.

Low Operating and Maintenance Costs

Two power units of the same general type described, but not provided with material boxes, have been in service at the South Pekin (Ill.) car-repair yard of the North Western, since April 12, 1929, and an accurate record has been kept of operating and maintenance costs. At this point, the actual average cost per day for gas, oil and other lubricants is reported to be $0.865 per car, or an average of $0.108 per hour per car. The cost of repair material up to the present time amounts

to $32.48 and the cost of labor in making repairs $53.65, a total of $86.13. On this basis, the cars have operated three years at an average annual cost of $28.70. It is anticipated that, within the next 12 months, it will be necessary to rebore the cylinders, install new pistons, rings and valves on these motors, at a cost of about $100 per car in labor and material—repairs which will place the cars in condition for at least two years of uninterrupted service.

With the new combination power unit and material-handling car, the possibilities of saving will be greatly increased, since approximately 85 per cent of the material used in car repairs can be carried on the car proper without the use of trailers, thus automatically reducing the number of trailers required. The provision of the crane feature permits the heaviest materials to be picked up by the driver alone, carried on the car and distributed to the point of repairs. This saves the part-time labor, for example, of three or four men who would be required to handle bolsters, etc. The power unit is also successfully used in making separations between cars, when necessary, this operation ordinarily requiring that four to six men stop their work temporarily and assist in the moving of the cars.

Standardization of trailer equipment is another important feature. With the former method, many types of trailers were used and the maintenance cost was high. Under the motorized narrow-gage arrangement there are

Convertible high swing-side gondola designed for use on narrow-gage tracks

only two types of trailers, one being the combination wheel carrier used for the handling of wheels and lumber, and the other the combination three-in-one car described. The outstanding advantage, however, is the fact that one man, the driver, delivers all material, and it is estimated conservatively that with this power unit the time of five men is saved.

The operation on rail is speedy, and wear and tear on the machine and track is small, automatically reducing operating and maintenance cost. The system is flexible, operating readily to any part of the yard and to any material-distribution point. On account of the operation being restricted to a fixed, narrow space, the danger to employees is minimized and no injury has been reported in three years of operation. Inclement weather has no effect in retarding the operation. In one yard, where this method of material distribution is in effect, having approximately 45 men employed and a normal output of about 40 to 45 cars a day, the operation of two power cars (two men) completely took care of the supplying of all material; in fact, on many days one of the cars was used only one-half day. Without the use of these cars, it is estimated that it would have required ten men to supply the material by hand power.

Making generous allowances for maintenance, depreciation and interest charges, experience on the Chicago & North Western has indicated that this motorized narrow-gage delivery system for car-repair materials will show from 150 to 450 per cent annual returns on the investment, dependent upon whether or not the car-repair yard is already equipped with narrow-gage tracks.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car Damaged—No Record of Unfair Usage

Fort Smith & Western car No. 6066 was delivered to the St. Louis-San Francisco at Fort Smith, Ark., June 7, 1931, without exceptions. This car remained on the lines of the Frisco until it was offered to the Fort Smith & Western in interchange January 16, 1931. The car was refused by the Fort Smith & Western on account of two intermediate sills being broken BL; two intermediate sills broken BR; one train line bent B; two side sills wheel marked R. & L. B. The F. S. & W. contended that a joint inspection report, which was attached to its statement, was sufficient to place the responsibility for the damage on the handling line and, therefore, the Frisco bill for $95.86 should be cancelled. During the discussion previous to submitting this case to the Arbitration Committee the Frisco contended that the defects originated on the Rock Island during October, 1930. The F. S. & W. claimed, however, that since the Rock Island had admitted responsibility for the defects and had issued a defect card covering, and since the car was reconditioned in November, 1930, with four new sills and accepted in January, 1931, by the Frisco, the contention of the handling line had no bearing on the case. In its statement the Frisco pointed out that the F. S. & W. took exceptions to the defects, contending that the car had been in a derailment. The handling line stated that it made a thorough investigation of the movement of the car over its rails and had found no record of a derailment. An inspection of the car showed that repairs to the arch bars had recently been made by someone and that one pair of wheels bearing the Rock Island marking had been applied. Correspondence with the Rock Island developed that the wheels were changed on its lines at Armourdale, October 23, 1930, on account of worn-through chill and that there were no delivery-line defects on the wheels and axle. The Rock Island also removed and repaired one top arch bar BL on account of being bent and renewed four column bolts at the rear end, handling line responsibility. Two intermediate sills were also broken on account of the derailment, and the Rock Island gave the car no defect card covering. At first it appeared probable to the Frisco that the existing damage to the sills had occurred on the Rock Island, but investigation by the F. S. & W. developed that it had repaired the damage which occurred on the Rock Island. This definitely established that the derailment on the Rock Island October 23, 1931, was not the cause of the damage which existed on the car on

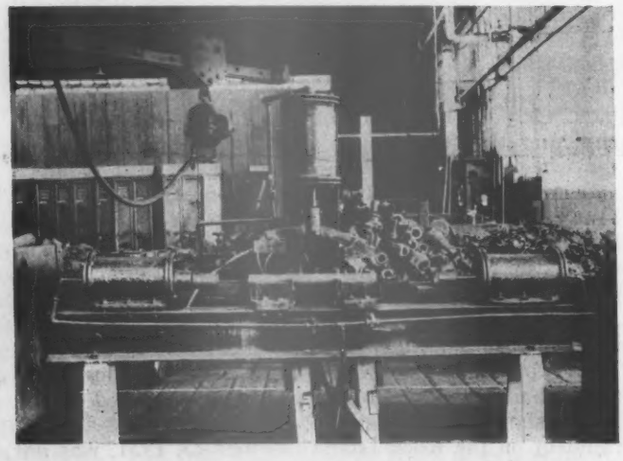
January 16, 1931, and had no connection with it. The car remained on the interchange between the Frisco and Fort Smith and Western for some time and was finally repaired by the Frisco. The car was then offered back to the F. S. & W. on March 5, 1931, and was accepted by the car owners without question. The F. S. & W. however, declined to pay the bill for repairs, contending that the damage occurred in a derailment, and submitted the joint inspection report signed by representatives of the Missouri Pacific and the Kansas City Southern to that effect. The Frisco, however, was later advised by the Missouri Pacific and the Kansas City Southern inspectors that they were basing their belief on the evidence that new wheels had been applied and the arch bar straightened, and they were of the opinion that all the damage had occurred at the same time. In view of the evidence that the repairs to the arch bar and wheels had no connection with the damage which existed on January 16, the Frisco claimed that the contention of the Fort Smith & Western was in error. It also called the attention of the committee to the fact that there is no combination according to Rule 44, as only four sills were broken, the two side sills merely being wheel marked and not damaged sufficiently to justify repairs. It was the contention of the Frisco that, according to interpretation 3 of Rule 4, this damage was the car owner's responsibility and that its bill for repairs was proper.

The following decision was rendered by the Arbitration Committee, April 7, 1932: "No conclusive evidence is presented to indicate that the defects in question were due to any of the causes enumerated under Rule 32. The contention of the car owner is not sustained." —*Case No. 1691, Fort Smith & Western vs. St. Louis-San Francisco.*

Device for Mounting Steam-Heat Hose

THE device shown in the illustration greatly facilitates the mounting of steam-heat hose. It consists of three eight-in. air-brake cylinders mounted as shown which clamp the hose in a rigid position while the nipple and coupling are being forced into the ends. Two pieces of 1½-in. by 6-in. bar iron are formed to stand 18 in. from the floor and upon this are two 8-in. channels about 10 ft. in length. The two horizontal cylinders are bolted to the channels with the piston push rods facing each other. Two wrought-iron blocks are secured to the channels in the center and directly under the center cylinder. These blocks are formed on the top to permit one-half of the hose to rest in them so that the hose will not flatten when the clamp is applied. The center cylinder is equipped with an arm, on each end of which is a casting formed to fit the hose. The gage shown on each of the bottom blocks indicates to the workman when the steam-hose head and nipple are applied to the proper depth and also insures that the rubber hose is placed correctly on the blocks.

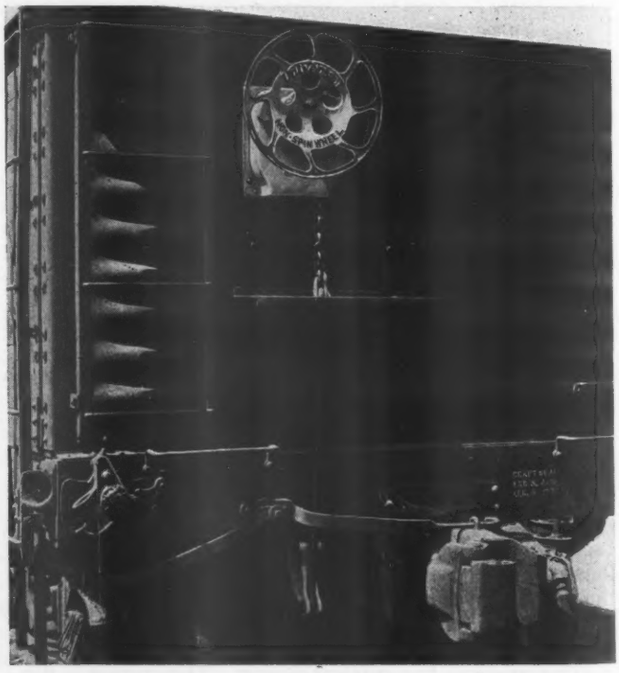
Each cylinder is operated independently. This is necessary in order that the head and nipple are set into the hose flush with the edge, thus eliminating the expansion of the tubes which would not permit a good seat for the hose clamps.



The hose is held while the ends are applied

Non-Spin Wheel Safety Hand Brake

THE Universal Draft Gear Attachment Company, Chicago, has recently placed on the market a freight-car hand brake, known as the Non-Spin wheel brake, with general operating principles based on its tunnel-type passenger-car brake having a non-spin wheel, which has been in use several years. The features of this new hand brake include full power development, equivalent to that of the air brake, with one hand; easily graduated or full release, also with one hand and without back spinning of the wheel, and consequent danger to trainmen; reliability and long service life by the use of heat-treated alloy steel for all parts subject to greatest stress and wear, and ability to repair or replace the chain without removing the brake from the car.



Universal brake with a non-spin hand wheel

In setting up this hand brake, a safety holding pawl functions to hold the static forces only, avoiding excessive stresses, wear and breakage. The safety pawl

is in engagement at all times, preventing backward movement of the brake wheel, except when it is intended to reverse the wheel for a gradual or partial release. The safety pawl is moved to disengagement by gravity only after having been relieved of all stress.

The wheel and winding shaft function as a unit in setting the brakes, but are separated to effect full release which is positive and instantaneous. The power unit is supported and protected by a front housing of malleable iron with integral bearings and bronze bushings.

All chain is proof-tested and no special welded-end links are required to attach the chain to the brake, vertical brake rod, top rod, or to the segmental sheave at the end sill. This introduces an additional factor of safety and reduces the first cost and the maintenance expense.

The principal object of the Non-Spin wheel is to prevent throwing car riders off balance or from cars when high-power brake applications (sometimes both air-brake and hand-brake power) are suddenly released. The clutch arrangement embodied in this brake makes it convenient and practical to release high power entirely, or partially, with one hand and without the usual wear and failure of parts affected by that operation.

Checking the Braking Force on Cars

By Levander Brown

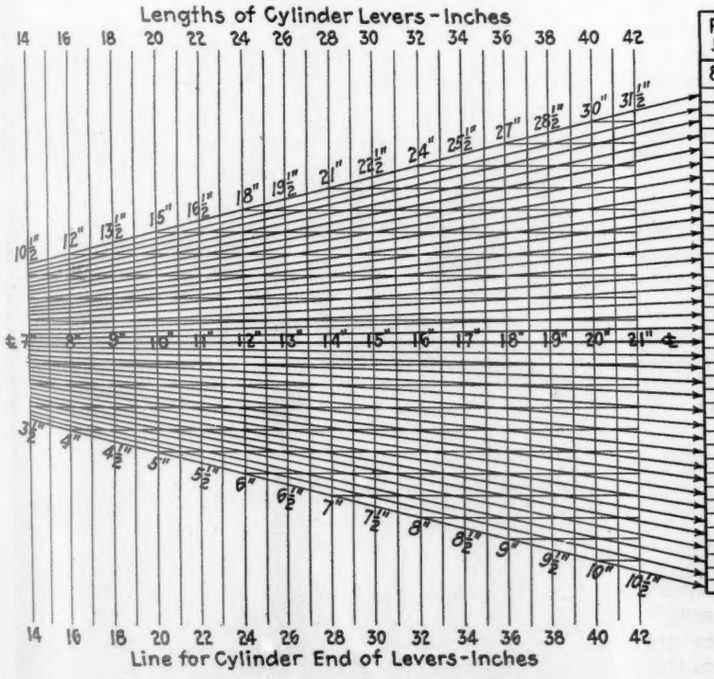
THE article, "Checking Braking Force on Cars," on page 460 of the September, 1931, issue of *Railway Mechanical Engineer* reminded the writer of a chart which he devised for showing at a glance the power developed by air-brake cylinders of various diameters through levers of various lengths. This chart, is designed to assist engineers, draftsmen, foremen and inspectors to determine proper braking powers with less difficulty by avoiding the somewhat complicated calculations involving the cylinders and the cylinder levers.

This chart may be used in two ways; one, by starting from the cylinder lever to determine what weight of car is suitable for levers already drilled and the other by starting from the truck levers when it is desired to know where the intermediate drilling should be located in the cylinder levers.

The graphical portion of the chart is arranged symmetrically above and below the horizontal center line. The vertical lines represent commonly used cylinder levers from 14 in. to 42 in. as shown by the figures and lines. The latter are drawn 1 in. apart. Intermediate lengths may be obtained by interpolating.

These lengths correspond with the distances from the center to center of the outer or extreme drillings on the levers. The horizontal lines show in inches the possible locations for intermediate drillings, with additional intermediate locations also obtainable by scaling the chart. The measurements for the lever lengths and intermediate drillings start from the cylinder or power end of the levers. The diagonal lines, including the center line, are directional and lead from any particular location on the levers to the arrow points on the right, and vice versa. The tabulated figures on the right show the power available at that end of the cylinder lever which is furthest from the cylinder. The amounts of power shown vary with the diameters of the cylinders and also the intermediate drillings of the levers as indicated by the locations where the diagonal lines cross the vertical and horizontal lines on the left.

The figures in the space directly opposite the center line are the pressures supplied directly by the cylinders themselves based on a 50-lb. brake-cylinder pressure. These are calculated by multiplying the area of the



Power in pounds developed from air brake cylinder at 50 lb. per sq. in. through cyl. levers of various lengths

8" Cyl.	10" Cyl.	12" Cyl.	14" Cyl.	16" Cyl.	18" Cyl.	20" Cyl.
7539	11781	16965	23091	30159	38169	47124
7010	10955	15775	21471	28042	35490	43820
6534	10210	14703	20012	26138	33080	40843
6103	9537	13733	18691	24413	30898	38149
5711	8925	12852	17491	22846	28917	35700
5354	8366	12048	16397	21417	27108	33466
5026	7854	11310	15394	20106	25446	31416
4724	7383	10631	14470	18900	23920	29532
4446	6947	10005	13618	17786	22510	27790
4188	6544	9424	12827	16753	21204	26180
3949	6171	8886	12095	15798	19993	24685
3726	5822	8384	11411	14905	18865	23290
3518	5498	7917	10776	14074	17812	21991
3323	5193	7478	10179	13295	16826	20775
3141	4908	7069	9621	12567	15904	19635
2969	4640	6682	9095	11879	15035	18562
2808	4389	6320	8602	11235	14218	17554
2656	4151	5978	8136	10627	13449	16605
2513	3927	5655	7697	10053	12725	15708
2377	3715	5349	7281	9510	12036	14860
2248	3513	5059	6886	8994	11383	14054
2126	3322	4785	6512	8506	10765	13290
2010	3141	4524	6157	8042	10178	12566
1900	2969	4275	5819	7601	9620	11877
1795	2805	4039	5497	7181	9088	11220
1695	2648	3813	5191	6780	8580	10593
1599	2499	3598	4898	6397	8096	9995
1508	2356	3393	4618	6032	7634	9425
1420	2219	3196	4351	5682	7191	8876
1337	2089	3008	4094	5347	6767	8355
1256	1963	2827	3848	5026	6361	7854
1180	1843	2654	3613	4718	5972	7373
1106	1728	2488	3386	4425	5598	6912
1035	1617	2328	3169	4139	5238	6467
967	1510	2175	2960	3866	4893	6041
901	1408	2027	2759	3604	4561	5631
838	1309	1885	2566	3351	4241	5236

Chart devised for the easy calculation of braking force on cars

Example—To find the location of the center hole in the cylinder lever of a car weighing 100,000 lb., with a 10-in. brake cylinder, 60 per cent braking force and a total truck-leverage ratio of ten. 100,000 × .60 ÷ 10 = 6,000. The nearest figure to this amount in the column for 10-in. brake cylinders is 6,171. Assuming the length of the levers to be 40 in., we find that the center hole should be located 24½ in. from the cylinder end. Count the spaces up from the figure 20 on the center line where it intersects the vertical 40-in. lever line to the intersection of the diagonal line—4½ spaces. 20 plus 4½ = 24½ in.

cylinder by 50 lb. for each square inch. For example:

$$8 \text{ in.} \times 8 \text{ in.} \times .7854 \times 50 = 2{,}513 \text{ lb.}$$

The rule for the three well known orders of levers is that the power when multiplied by the distance it moves is equal to the force exerted when multiplied by the distance it moves; from which it may be seen that when the intermediate drillings of the cylinder levers are mid-way between the outer drillings, the two ends of the levers move the same distance and the force exerted is equal to the power supplied. The same rule applies to all the other intermediate drillings, with results as indicated on the graphical portion of the chart and the tabulated figures on the right.

Assuming that 2,513 lb. is exerted at the furthest end of a front cylinder lever attached to an 8-in. cylinder and that each of two levers on the connected truck multiply the power three times, or a total of six times for that end of the car, and assuming that the rear cylinder lever produces a similar power on the other truck, we find a total of

$$12 \times 2{,}513 = 30{,}156 \text{ lb.}$$

which represents the braking power for the car. Assuming that 60 per cent is the relative braking power, we find the weight of the car to be 50,260 lb. Conversely assuming the weight of the car is 50,260 lb., with 60 per cent braking power equaling 30,156 lb., this latter figure divided by a total truck leverage of 12 shows that we require 2,513 lb. at the end of the cylinder lever furthest from the cylinder.

As a leverage of 12 times the cylinder pressure causes too great a reduction of clearance between the brake shoes and the wheels, which are limited by the movement of the cylinder piston, it is apparent that an 8-in. cylinder exerting a maximum of 2,513 lb. of power, is too small for a car weighing 50,260 lb. Inspection of the next column in the table which is for 10 in. cylinders, shows that the figure 2,499 is the nearest quantity to 2,513 lb. and that the total required braking power of 30,156 lb. is less than eight times the maximum cylinder power of 3,927 lb. developed in a 10-in. cylinder. This arrangement will provide for ample brake-shoe clearance. For the car in question, an inspection of the chart shows that by tracing the diagonal line from the figure 2,499 to the intersection of the vertical line representing a 36-in. lever, the location for the intermediate drilling in a cylinder lever of that length should be 14 in. from the cylinder end.

The dimension of 9 in. on the bottom diagonal line gives the basis for calculation; reading up the vertical line representing the 36-in. lever add one inch for each horizontal intersecting line to the intersection of the diagonal line from the figure 2,499.

This chart is not designed to calculate the braking force of cylinders and cylinder levers, but will be found to be a valuable time-saver in the checking of existing cars and cars being designed in the drawing room.

Conditioning Metallic Steam-Heat Connectors

IN the late summer or early fall all metallic steam heat connectors should be removed from passenger cars and sent to the designated shops where they are repaired. This program will prevent failures from this source during the winter season.

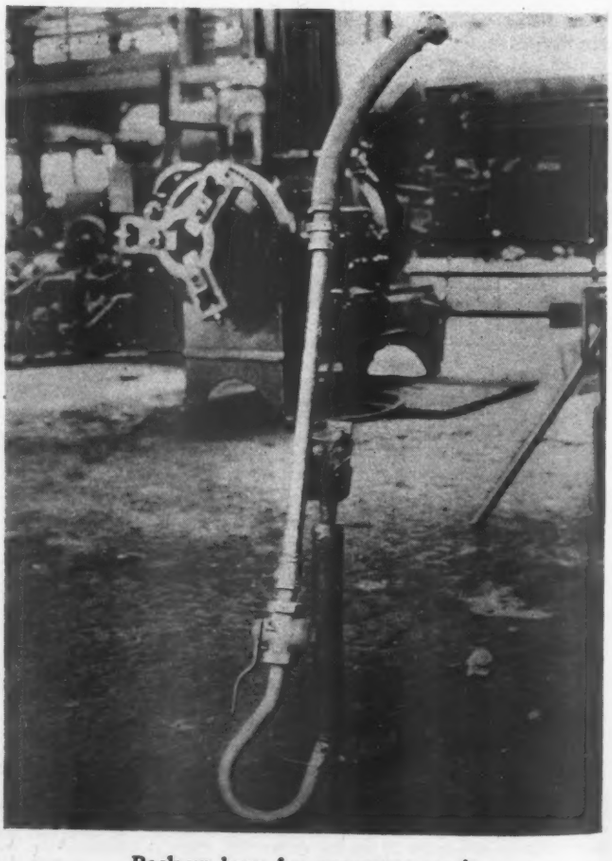
Regardless of their manufacture these connections must have the gaskets renewed at least once each year. The ball joints should be thoroughly cleaned and polished and the threads on the lock nuts graphited to prevent deterioration. To attempt to perform this work on each individual car on the repair track or in the train yard would result in a very costly operation for the reason that even though the gaskets and threads were given the proper attention no accurate tests could be made to determine the rigidity of the connector.

If selected workmen are assigned at a central shop and the metallic connectors are shipped in for general conditioning and a scheduled output is established each day this work can be performed at a minimum cost and the railroad will be assured of properly repaired connectors being applied to their passenger-car equipment when the cold weather season arrives thereby eliminating loss of steam due to leaks around the joints and in many cases prevent the many delays which result from failures of these connectors, a large percentage of which are due to neglect or improper maintenance.

Rigidly Constructed Back-up Hose

THE illustration shows a back-up hose that is used for backing up passenger trains. The cost of manufacture is very low and due to its rigid construction there is practically no maintenance expense.

The loop is formed from a piece of one inch wrought iron pipe about 24 in. long, one end being threaded and attached to a 1-in. cut-out cock. A short nipple is applied to the other end of the cut-out cock and to this, next in turn, is applied a one inch pipe tee. If it is desired to connect a warning whistle to the back up hose it is attached to this tee. An ordinary ¾-in. self-closing valve is used and to it is attached a whistle of



Back-up hose for passenger service

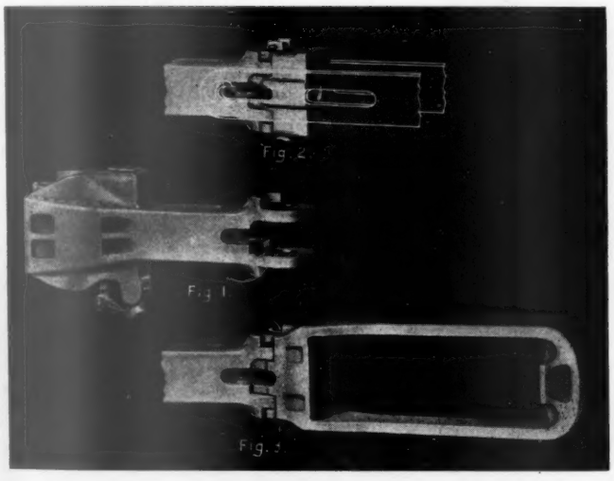
the desired type. A section of one inch pipe of desired length, preferably about two feet long is then attached with a 1¼-in. to 1-in., reducer used to attach to an ordinary air-brake hose.

In applying the back-up hose to the rear passenger car, the air hose on the car is coupled to the hose of the back-up connection and the loop at the other end is hung over the end or tail gate. With the brake-pipe pressure turned into the back-up hose the trainman can either reduce the speed of the train by the manipulation of the cut-out cock handle or can immediately apply the brakes in emergency should the occasion present itself.

Due to the rigidity of construction this back-up hose can be handled quite roughly when removed from the train without causing breakage or damage due to distortion.

The A.R.A. Swivel Type "E" Coupler

THE American Railway Association, after consideration of the recommendation by its Coupler and Draft Gear Committee, adopted as alternate standard the swivel-shank coupler and necessary swiveling attachments shown and described in this article. This action was the result of increasing demands by various railroads for a single standard swiveling type coupler for freight-car service. This device was accordingly adopted by letter ballot in 1931, becoming effective as alternate standard of the American Railway Association on March 1, 1932. The swivel type coupler is manufactured by the following companies in the United States and Canada: American Steel Foundries, Chicago; Buckeye Steel Castings Co., Columbus, Ohio; Gould Coupler Company, New York; McConway & Torley Corp., Pittsburgh, Pa.; National Malleable & Steel Castings Company, Cleveland, Ohio; The Canadian Steel Foundries, Ltd., Montreal, Que., and the Dominion Foundries & Steel, Ltd., at Hamilton, Ontario.



Type "E" swivel-shank coupler and attachments

The coupler body shown in Fig. 1 comprises an A.R.A. standard coupler head and parts, with a standard shank section terminating in hinge loops which fit into corresponding pockets in the butt casting or swivel yoke.

The swivel butt casting shown in Fig. 2, when connected to the swivel-shank coupler, using the swivel pin, forms a complete coupler for application to the horizontal yoke.

When the swivel-shank coupler is applied to the vertical yoke arrangement, it is attached directly to the front of the swivel yoke as shown in Fig. 3, using the same standard swivel pin. The swivel pin, which is furnished under the A.R.A. specifications for coupler-knuckle pivot pins and swivel pins for swivel-shank couplers, is common to both types of attachment. The pin is in quadruple shear when under draft, but is relieved of buffing stresses by elongated pin-holes in the swivel shank.

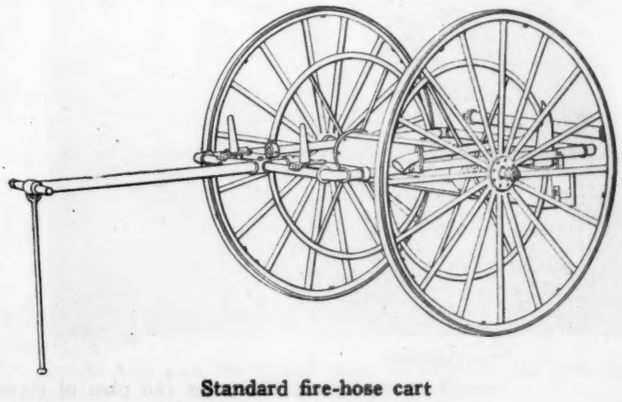
These stresses due to buffing are sustained by the shank loops and also by auxiliary shoulders on the top and bottom of the shank.

Tests conducted by the Mechanical Committee of the Coupler Manufacturers, under the supervision of the A.R.A. Coupler and Draft Gear Committee, have shown that the swivel shank coupler compares favorably with the standard rigid shank coupler applied with similar yoke arrangement. Reference can be made to 1931 Proceedings of American Railway Association, Division V, Mechanical, pages 425 to 444, inclusive, for complete details of test results. Complete specifications including tables of comparative weights, may be found in the A.R.A. Manual, Section A, pages 41 to 59, inclusive.

Shop Fire-Fighting Equipment

THERE is an old saying to the effect that it does not pay to lock the barn door after the horse has been stolen. Likewise, it does not pay to secure adequate fire-fighting equipment and trained fire-fighting personnel after the shops have burned down. Many railroad shops are well equipped to fight fires. It is also noted that the shops with good equipment have gone to considerable trouble to train the shop forces in fighting fires, especially where the fire hazards are great. Practice alarms are made at least once each week and sometimes more often. These alarms are not scheduled, but are had at unexpected times to secure the best possible results from the standpoint of practice and training.

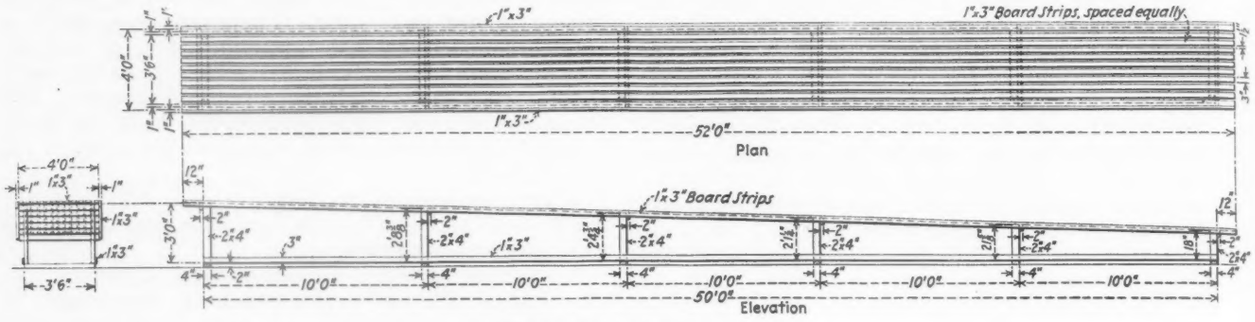
The equipment and firehouse shown in the three drawings are standard on a large eastern road. Referring to the drawing of the fire-hose cart, the tongue is constructed of 1⅝ in. outside diameter tubular steel. It extends from the frame 3 ft. 4 in. and is connected to the frame by a rivet and bolt. The



Standard fire-hose cart

handle bar is of malleable iron riveted to the tongue. A tongue rest of ⅝-in. steel is attached to the handle bar. The frame is constructed of 1⅝-in. and 1¼-in. outside diameter tubular steel, bolted and riveted through malleable-iron castings. The friction roller

The hose cart is provided with two cone-shaped nozzle holders which are mounted on the frame, one set of malleable-iron axe holders, and a steel tool box. It is painted vermilion, varnished and striped in gold. The reel has a capacity for 300 ft. of 2½-in. double



Rack for drying fire hose

on the rear end of the frame is of 2⅜-in. outside diameter tubular steel.

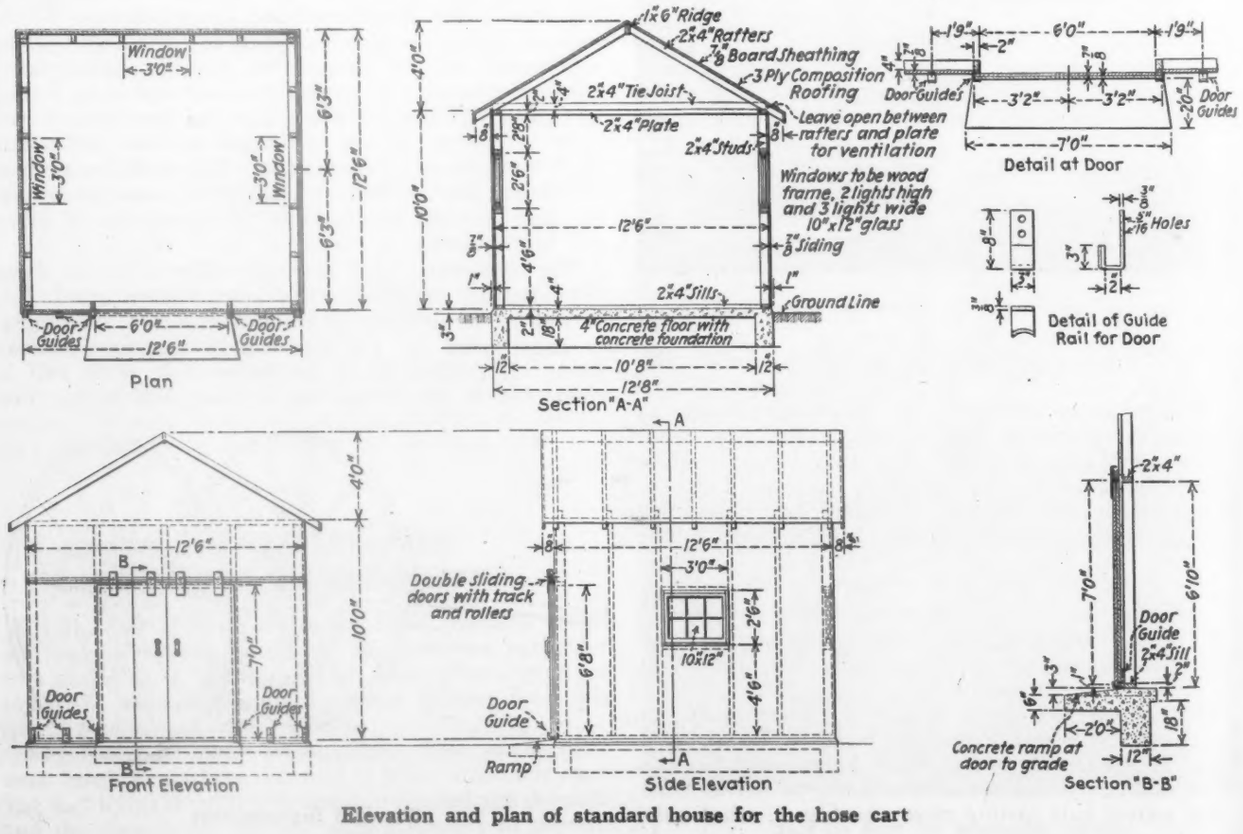
The rims of the reel are of 1 1/16-in. outside diameter tubular steel and have ½-in. round-steel spokes. The reel heads are of malleable iron and the reel center is made of No. 12 gage sheet steel. The rims are fastened at the joints with a ¾-in. dowel pin and are riveted with two ¼-in. rivets. They are 37 in. in diameter and the reel center or drum is 34 in. long and 7 in. in diameter.

The axle is of 1¼-in. by 4-ft. 6⅛-in. round machine steel. The wheels are secured by ⅞-in. R. and L. nuts, for which a malleable-iron wrench is provided. The wheels are of wood, 4 ft. 4 in. in diameter, and have 1¼-in. spokes. The tires are of malleable iron, 1¼ in. by ¼-in. The wheel-hub bearings are 6 in. long.

jacket cotton, rubber-lined hose. The cart has an overall length of 8 ft. 9 in. and an overall width of 4 ft. 6⅛ in. It weighs about 270 lb.

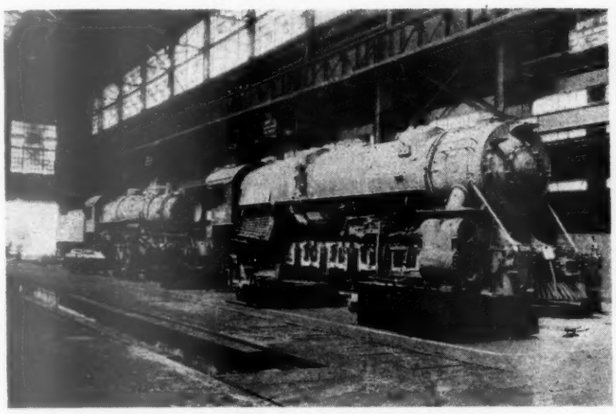
The rack for drying hose is 50 ft. long and is 3 ft. high at one end and slopes to 18 in. at the opposite end. This slope is sufficient to drain off the water. The hose is laid on the rack in 50-ft. coils. Openings of 1½-in. between the 1-in. by 3-in. board strips allow circulation of air and also prevent water collecting under the hose.

The hose-cart house, the construction of which is shown in one of the drawings, is the standard building for the hose cart described in the preceding paragraphs. It is 12 ft. 6 in. square and is provided with a 4-in. concrete floor on a concrete foundation. It can be constructed with board sheathing or sheet iron as desired.



Elevation and plan of standard house for the hose cart

In the Back Shop and Enginehouse

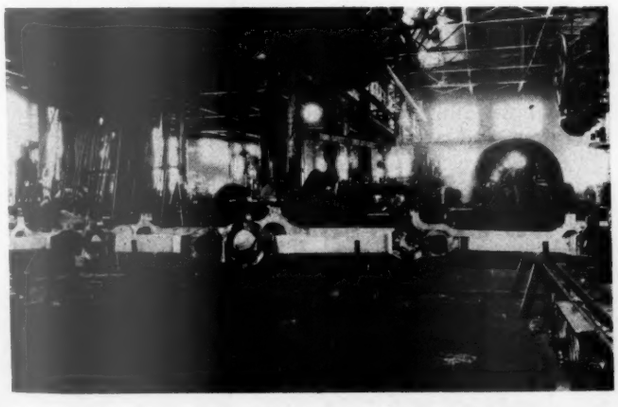


The wheeling pit at 3:30 p.m.

Wheeling A 2-10-2 Type Locomotive

IN the January, 1931, issue of *Railway Mechanical Engineer* a description of the method of handling locomotive repairs under the "spot" system at the Glenwood, Pa., shops of the Baltimore & Ohio was described. That article also gave a detailed study of the operations and time involved in the erecting shop part of the job of wheeling an eight-wheeled switcher. The present article will describe briefly the operations and time involved in wheeling a 2-10-2 type locomotive in the same shop.

All of the wheeling operations in the Glenwood shop are performed on the second trick and no part of the

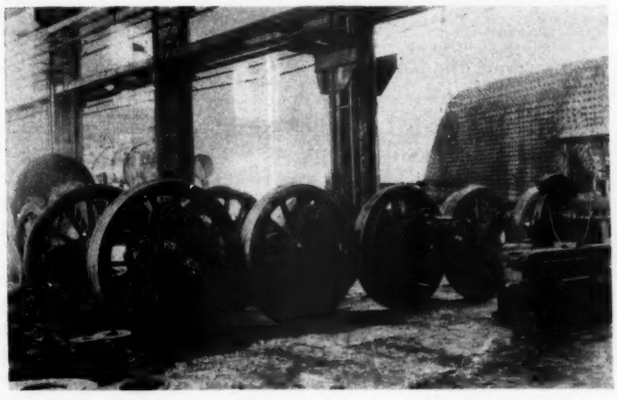


The rods assembled on the floor at 2:30 p.m.

work in connection with the wheeling of a locomotive is started until the wheeling gang comes on duty after 3:30 p.m. The rods are assembled ready in the rod shop and the wheels and boxes, as well as the shoes and wedges, are ready in other departments for transporting to the wheeling pit. For the benefit of those who may not have read the article previously mentioned, Glenwood shop is a longitudinal shop with three tracks in the erecting shop and two 100-ton overhead cranes to handle the locomotives. The machine groups are adjacent to the erecting shop and in the wheel department stub-end tracks project out into the erecting bay from which the wheels are picked up by the erecting cranes.

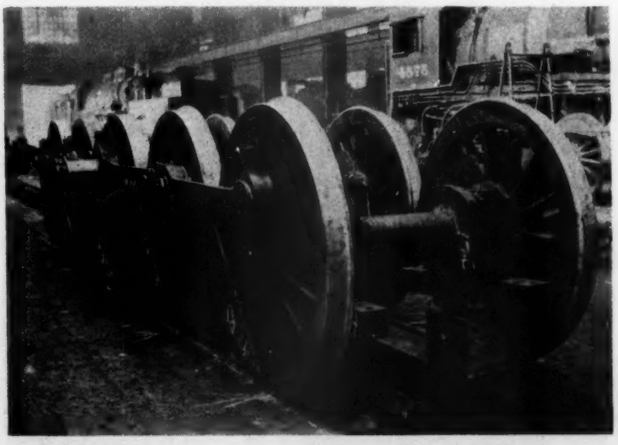
Wheeling Performed by Machinist and Two Helpers

The wheeling is performed by a machinist and two helpers with the assistance of two crane operators and a crane director on the floor. The first operation is to mark on the floor the location at which it is desired to place each pair of wheels. The wheeling gang, having

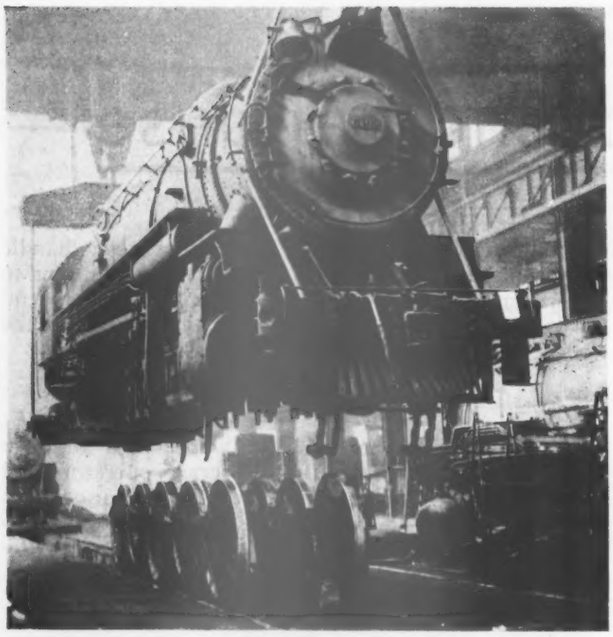


The wheels in the machine shop at 2:35 p.m.

come on duty at 3:30 p.m., had this completed at 3:38 p.m. and one of the erecting cranes had gone for the first pair of wheels which were placed on the wheeling pit at 3:41 p.m. Successive pairs (five in all) were placed in position at 3:43, 3:46, 3:50 and 3:52 p.m. and as each pair was placed the crank pin collars and nuts were removed and laid on the floor. While these wheels were being placed the other erecting crane had brought



At 4:23 p.m. the wheels were all in place, the rods on and the binders up on blocks

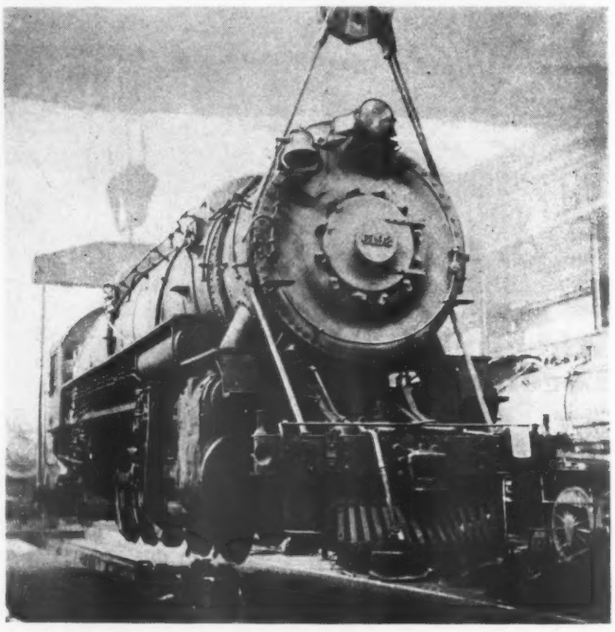


Lowering the locomotive on the wheels at 4:30 p.m.

the assembled rods from the rod shop, the left side rods being in position on the pins at 3:55 p.m. and the right side rods all on at 4:01 p.m. The placing of the rods also included the replacement of the crank pin collars and nuts. The lining-up of the rods was completed at 4:03 p. m.

After the rods are all on one of the two cranes proceeds to the adjacent pit to put the lifting yoke in position for lifting the engine. While these preparations are being made the machinist and one helper are turning all the driving boxes right side up, placing the binder supporting blocks in position on the shelves at each side of the wheeling pit, laying the shoes and wedges in a convenient place between the wheels on the floor and checking the driving-box cellars. The other crane, while the machinist is at each wheel, lifts the binders over from the floor and they are properly placed on top of the blocks under the axles. The crane is then released and proceeds to put the front end sling in position. The last binder was placed on the block at 4:23 p.m. and two minutes later the two cranes started lifting the locomotive over to the wheeling pit. In the meantime all the shoes and wedges have been put in position and at 4:30 p.m. the engine is over the wheels preparatory to lowering. At 4:39 it is down on the boxes, at 4:47 p.m. the binder bolts have been tightened and at 4:50 the locomotive has been lifted over to the finishing pit —72 minutes after the crane started for the first pair of wheels.

The operations described here pertain only to the actual placing of the wheels under the locomotive and do not include the application of the main rods, the brake rigging or the final adjustment of the shoes and wedges or the side rod knuckle pin nuts. This work is performed in the finishing section of the shop. The engine and trailer trucks are also put under the locomotive in the finishing section. This operation involves a total of 30 min. for a machinist, a helper, two crane operators and a crane director.



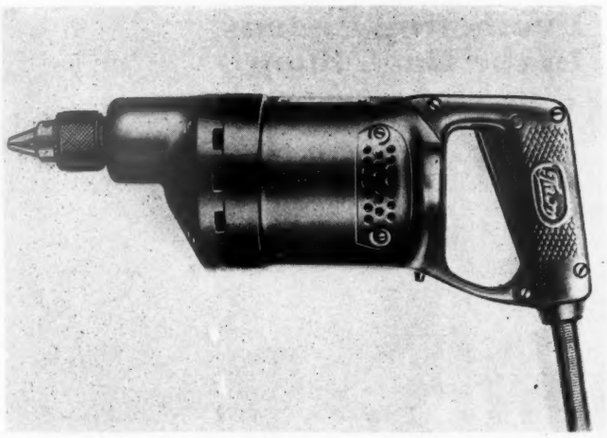
Ready for the finishing section at 4:50 p.m.

Down on the boxes at 4:39 p.m.

Two Universal Electric Drills

THE Independent Pneumatic Tool Company, 600 W. Jackson Blvd., Chicago, is now manufacturing two new electric drills—a ¼-in. size, with grip switch, known as "USA"; and a ½-in. size, with side switch, designated as "URA."

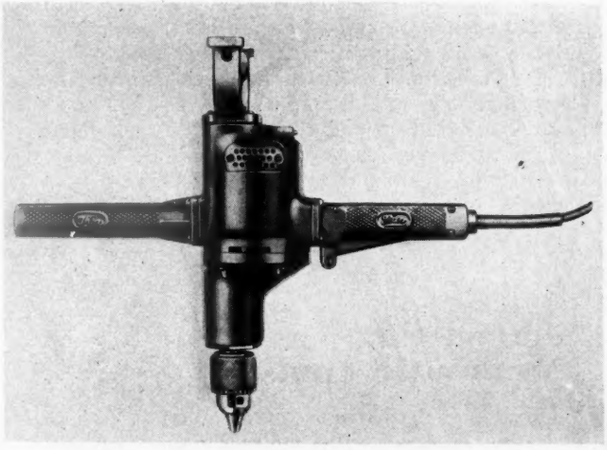
The armature shaft of the motor is made from alloy steel with pinions milled directly on the shaft. The armature core construction is of the open straight slot type which permits the use of separate form-wound coils to be laid into the slots without first being flattened. The commutator is made in one unit, independent from the shaft, and is balanced and tested at 1,100 volts before being assembled with the shaft. A brass sleeve is employed which expands and contracts in equal proportion with the copper bars, preventing an uneven sur-



Thor USA ¼-in. capacity universal electric drill

face and excessive sparking which cause melting of the solder on the lead wires.

Precision ball bearings of the closed back type are used throughout. This type of bearing prevents grease from entering into the motor because of suction of the fan and at the same time is subject to lubrication from the gear case because the open end of the bearing faces the gear case. The switch is of the double-pole type and brakes both sides of the line at the same time, thereby disconnecting the current from the line to the motor. The switch on the "USA" type is operated by a long lever and is so arranged that it can be changed to either



Thor URA one-half inch capacity universal electric drill

safety or positive switch by merely pressing the lock button on the side of the handle. The field case and handle are made of aluminum in one piece, with heavy rib work on the inside, which makes the outside of the case and handle free from bolt or stud lugs. The field case, gear case and centerplate have hardened and ground steel bushings, into which the outer race of the bearings fit, preventing loose bearings. Both ends of the spindle are provided with oversize ball bearings, one fitted into the centerplate bearing, thus forming a rigid and compact assembly, which prevents vibration and insures a true running chuck.

The USA has a capacity of ¼ in. The speed is 2,500 r.p.m. The weight is 8 lb. The URA has a capacity of ½ in. The speed is 500 r.p.m. and the weight is 14½ lb.

A Kink for the Drawing Room

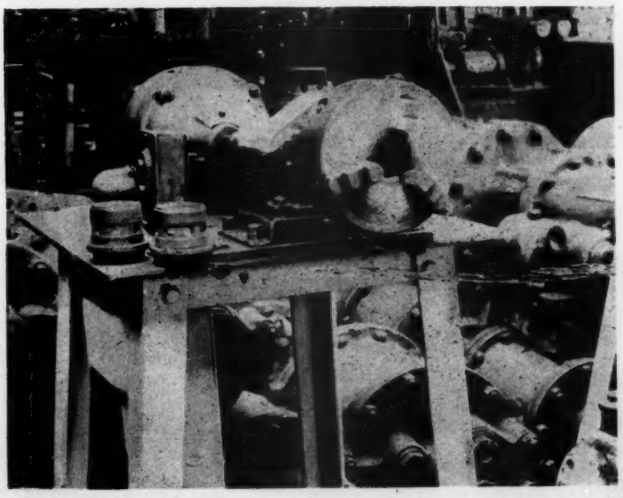
IT is frequently difficult to handle triangles on a drawing board, especially when the draftsman has considerable fine cross-section work to do. Triangles are also sometimes difficult to pick up with the ends of the fingers and frequently slip. A simple, but ef-

Rubber suction cups of the type used for holding ash trays and automobile anti-glare shields are handy for moving triangles

fective means of overcoming this difficulty is shown in the illustration. The draftsman purchased an automobile anti-glare shield in a five-and-ten-cent store and removed the rubber suction cups. Placing the suction cups on the triangles affords an easy way to handle the triangle, as well as a rest for the finger tips.

Grinding-In Compressor Valve and Cage Seats

TO insure that the seats of intake and discharge valves, and cages in air compressors are properly ground-in a shop superintendent provided the air-compressor shop with the equipment shown in the illustration. The stand is made from 3½-in. by 3½-in. angles and



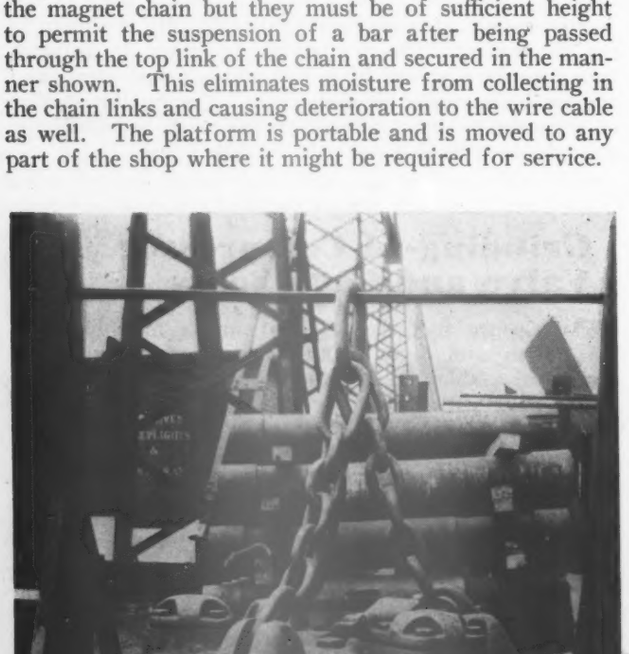
Portable power chuck for grinding valve seats

the table is 24 in. by 30 in., consisting of ½-in. boiler plate. A 5-hp. electric motor connected to a reduction gear, and to which is attached a mandrel is located in a convenient place in the shop. The intake or discharge valve is placed in the chuck and the seat of both the valve and the valve cage is coated with a liberal supply of valve grinding compound. The valve cage is held in the hands and ground in against the revolving valve seat.

This method insures that the same valve seat and cage are applied together in the air compressor which is not always the case when they are shipped to another part of the shop to have this work performed. It also prevents damage to the seats which previously occurred in handling the valves and cages from one shop to the other.

Rack for Crane Magnet

ELECTRIC magnets for use with shop cranes are not always in use. They are used in the loading and unloading of such material as units, flues, springs, etc., at the locomotive back-shops. The shop superintendent on one railroad devised the rack shown in the illustration for caring for a crane magnet when it was not in service. It consists of an oak platform of sufficient size to protect the entire base of the magnet raised six inches from the floor. Two uprights, 4 in. by 6 in., are attached to the platform and are securely braced to prevent leaning. The height of the uprights depends entirely on the length of the magnet chain but they must be of sufficient height to permit the suspension of a bar after being passed through the top link of the chain and secured in the manner shown. This eliminates moisture from collecting in the chain links and causing deterioration to the wire cable as well. The platform is portable and is moved to any part of the shop where it might be required for service.

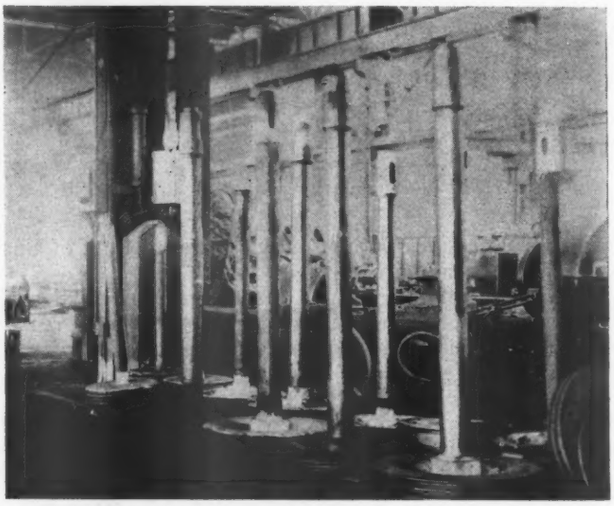


This rack protects the magnet from damage when not in use

Protecting Pistons In the Back Shop

USUALLY the floors of shops are either concrete or brick and materials or parts that are easily marred or damaged should not be permitted to come in contact with the floor.

In the illustration is shown a wooden platform upon which valve and cylinder pistons have been placed



Pistons are protected by storing on a platform

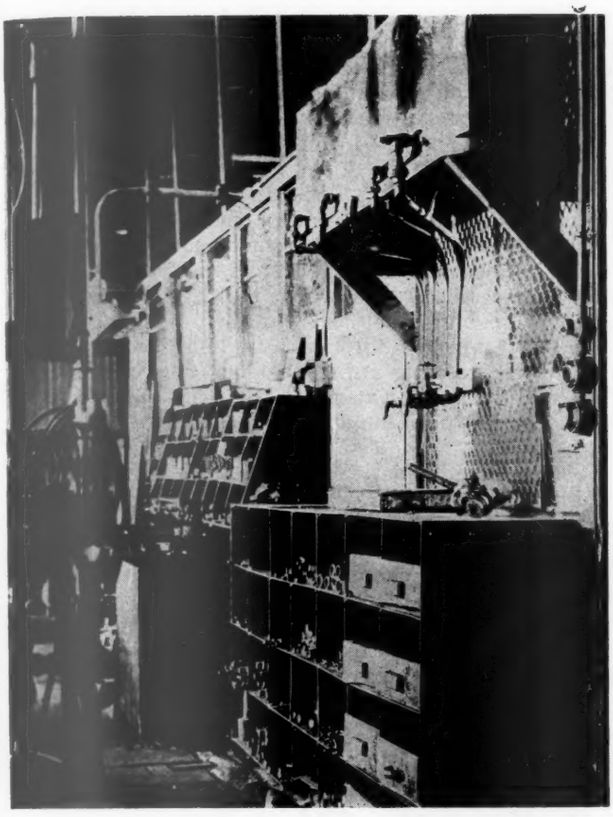
after having had the piston rods applied. Due to their weight these pistons must be handled either by jib or overhead cranes and if platforms are provided for them it will not only eliminate damage to the heads but will enable the shop foreman to keep the various sizes separated and will provide a more orderly arrangement.

The platform is constructed from oak lumber the boards being two inches thick and the bearings are of sufficient size to raise the platform six inches from the floor.

Lubricating Pneumatic Tools

SUCH pneumatic tools as hammers and motors should be returned to the tool room each day for adjustment and lubricating. The various sizes of hammers and motors require different grades of lubricating oils and greases and the work should be performed by a workman who is thoroughly familiar with these requirements.

The tool-room foreman employed by an eastern railroad devised the lubricating system shown in the accompanying photograph. Four different kinds of lubricating oils and greases are placed in separate compartments of a metal tank which is located over the table in the tool room where the machines are lubricated. The metal pressure tank is hydrostatically tested to permit a pressure of 110 lb. being used to force the grease through a ⅜-in. pipe to which a globe valve is applied about 12 in. above the table. Air pressure is constantly kept on the pressure tank and when a motor is turned in the filling plug is removed from the motor by the tool-room attendant, the old lubricants removed if they indicate foam or deterioration and new lubrication



Lubricants for pneumatic tools stored in a pressure tank with convenient outlets

forced into the motor by placing it under the proper spigot.

It is recommended that a storage tank be provided and the air screened before it is permitted to enter the pressure tank and come in contact with the lubricants as it sometimes contains grit and other foreign particles that are likely to cause damage when carried into the air tools.

Gasket Compound Proof Against Hot Oil

A NEW substance for gasket compounds which oil at high temperatures does not affect has been developed by the General Electric Company in its research laboratory, Schenectady, N. Y. The exposed edge of the gasket is not attacked, nor does the oil penetrate it. Oil-filled assemblies have been operated on test at from 210 to 230 deg. F. for a year without effect on the gasket and without leaks. The compound may be used in contact with cemented joints; neither dilute acids nor dilute alkaline solutions affect the gasket compound.

Designated as No. 1281 gasket compound, the material is a grey or brown, odorless and sulphur-free alkyd resin material, for which Glyptal is the trade name. It is flexible and practically incompressible, and there is no noticeable hardening or stiffening in outdoor exposure tests. At temperatures below zero F. the compound is somewhat brittle, but this does not affect its efficiency as a gasket when assembled in or applied to a joint.

Bushing assemblies of the compound with porcelain, brass, cast iron and copper have withstood alternate heating and cooling while under pressure and in contact with oil for long periods of time.

Among applications recommended are those where resistance to hot oil is of primary importance, where exposure to naphtha, gasoline, kerosene, benzine and similar solvents may occur, where moisture is to be excluded and oil resisted, where there may be prolonged exposure to ozone, and where electric corona may occur.

For bolted joints the gasket should be as thin as the strength of the parts and the nature of the surfaces will permit. Thicker gaskets are desirable for screw joints. The gaskets should be as wide as practical. The faces of the gasket should be covered as completely as possible by the clamping assembly so that minimum area is exposed, and, whenever possible, an enclosed gasket should be used.

The gaskets must be used under compression, with the clamping surfaces drawn up evenly so that compression is uniform. Allowance should be made for transverse distortion during clamping.

A sticker is not required for most applications, but where conditions to which the gasket is exposed are severe, as in salt-water exposure, etc., a pigmented Glyptal varnish, No. 1201, may be used as a cement and as a protective film. For screw joints the gasket should be lubricated with a thin film of mineral oil at the time of assembly, to permit the parts to slide easily on the gasket.

At present the material can be obtained in sheets up to 13 in. by 36 in., in thicknesses from one mil to ⅛ in. Round gaskets available at present have a maximum diameter of 12½ in. and a maximum thickness of ⅛ in., but larger sizes will be made available at a later date.

Shop-Made Automatic Float Valve

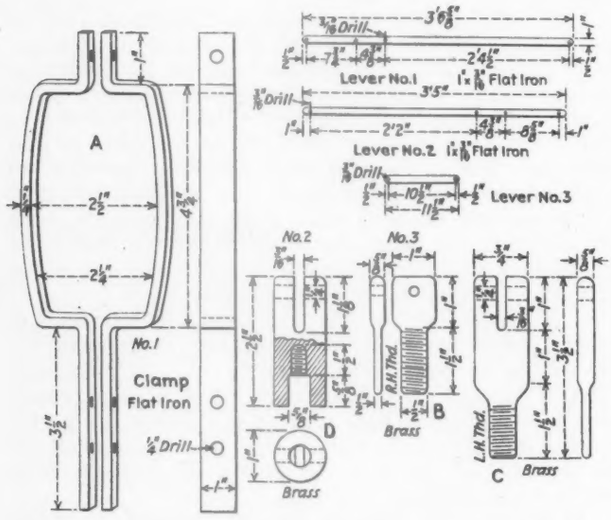
By A. Skinner

FOR a considerable length of time, trouble was experienced in a stationary boiler plant with a manufactured float valve controlling the water level in a feedwater heater tank, the valve being erratic in action and frequently sticking open. In an attempt to eliminate this difficulty, the float valve, illustrated, was

Shop-made automatic float valve installed ready for operation

made by reconstructing a scrap screw-type 3-in. gate valve and adding a few accessory levers and parts readily machined, or forged in the blacksmith shop.

Referring to one of the illustrations, the shop-made float valve and operating mechanism is shown installed and ready for operation. Detailed parts of the gate valve are shown in a second illustration, including the valve body, the valve stem, centerpiece, stuffing nut and discs.



Drawing of detailed operating parts required with the automatic float valve

The hand wheel is discarded because it was not required. The threads on the stem used in opening and closing the valve were turned off and the valve stem finished smooth, ⅝ in. in diameter. The centerpiece was filled with babbitt at the lower end, bored to ⅝ in. in diameter and lapped to a smooth running fit over the valve stem, which is guided at the upper end by the stuffing nut. With the stuffing box properly packed, the gate valve is then opened or closed by a direct pull or push on the upper end of the valve stem, this motion being controlled through suitable levers connected to a float valve which is located in the tank.

Referring to the drawing, details of the lever arrangement are illustrated. Clamp *A*, made of ¼-in. by 1-in. flat iron, is bent, as shown, and rigidly clamped around the gate-valve body. Brass piece *B*, flattened and drilled at one end for engagement with Clamp *A* is provided with a ½-in. thread and lock nut at the upper end for attachment to a 7-in. turnbuckle. Another brass fitting *C*, threaded to the upper end of the turnbuckle, is slotted to receive the horizontal operating lever. It is also connected to the valve stem by a third brass fitting *D*, machined as shown in the drawing. The left end of the horizontal lever, made of 1-in. by ¼-in. stock, is connected through a suitable offset vertical lever to the rotating arm controlled by or connected to the float in the hot-water tank. Details of the various levers are shown in the upper right corner of the drawing.

This automatic float valve is installed in a 3-in. water line to an open-type heater (1,000 hp.) which furnishes water to two Worthington outside-packed plunger pumps, having a 5-in. suction and 4-in. discharge. Water from the pumps is delivered to three 360-hp. Murray water-tube boilers, carrying 150-lb. gage pressure. The shop-made float valve, not patented, can be made at a cost not to exceed $5 and effects a substantial saving over the purchase of a new valve.

Automatic float-valve parts disassembled, showing changes in original construction

Combination Grinding and Buffing Machine

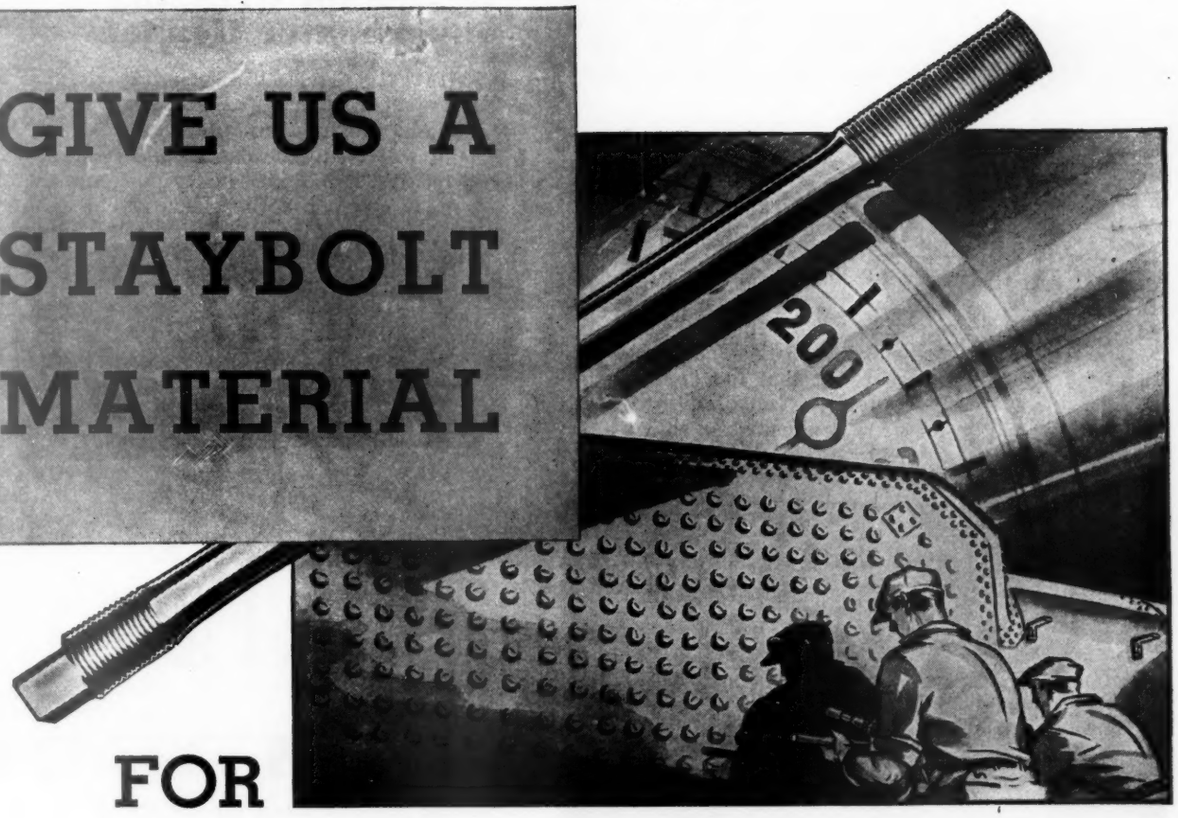
THE Standard Electrical Tool Company, Cincinnati, Ohio, has announced a new motor driven exhaust unit which may be mounted on its heavy-duty grinders and buffers. The illustration shows the combination grinding and buffing machine equipped with a 3-hp.

Exhaust unit mounted on Standard electric grinder

General Electric motor with automatic starter and push-button station. Both the grinder and buffer sides of

(Continued on next left-hand page)

"GIVE US A STAYBOLT MATERIAL



FOR OVER 200 LB. PRESSURES"

This was one of the staybolt problems presented to Republic metallurgists for which they found an answer. « For more than 10 years metallurgists and engineers of Republic Steel Corporation and its subsidiaries have been working with railroad men, in different parts of the country, on the development of staybolt materials which will successfully meet the loads imposed upon staybolts by modern pressures, high temperatures and operating speeds. The high vibration and the increasing temperatures in the modern high pressure locomotives have resulted in staybolt troubles which were unknown in the early days. To meet these conditions new staybolt materials have been developed. « Republic's records of laboratory service and tests cover a long series of developments. All this information, together with many service records will be made available to any railroad official who is interested in improving staybolt performance.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Staybolts, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Nitralloy • Agathon Iron for pins and bushings Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel (20-27 Carbon)

TONCAN COPPER Molybdenum IRON

AGATHON NICKEL IRON

The Birdsboro Steel Foundry & Machine Company of Birdsboro, Penna., has manufactured and is prepared to supply under license, Toncan Copper Molybdenum Iron castings for locomotives.

CENTRAL ALLOY DIVISION

REPUBLIC STEEL CORPORATION

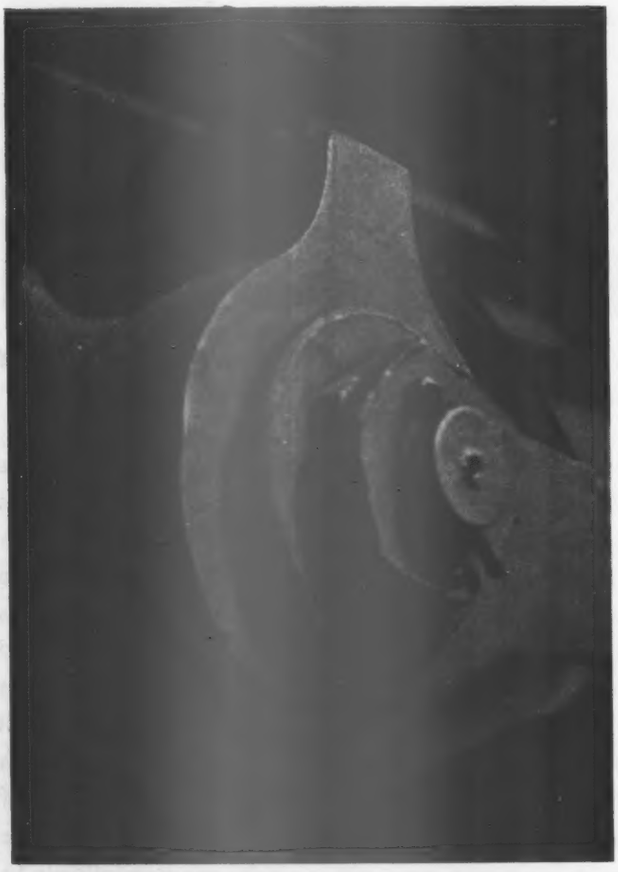
MASSILLON OHIO

the machine are fitted with enclosed hinged door guards.

On the back of the pedestal is mounted a ¾-hp. 3,600-r.p.m. motor-driven exhaust unit fitted with a dust collecting bag. The net weight of this machine is 846 lb.

Distorted Knuckle and Crank-Pin Nuts

THE nuts on crank pins, knuckle pins and main rod strap bolts should be given as much care as any other part of the locomotive. Frequently, however, engines arrive at the back-shops with these parts battered and distorted to such an extent that they must be removed with a chisel because it is impossible to use a standard wrench on them. The illustration shows a nut that has been tightened with a hammer and while it is



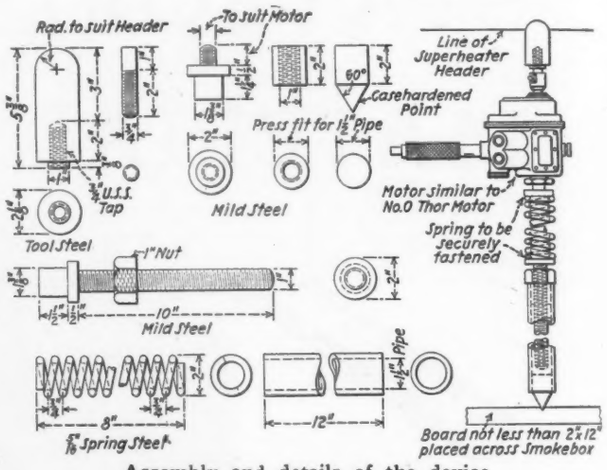
A crank-pin nut damaged from being tightened with a hammer

not yet damaged to the extent that a standard wrench cannot be applied on it, further use of a chisel or hammer will destroy it entirely.

Several months ago a campaign was inaugurated by an eastern railroad to eliminate this practice with the result that today it is hardly possible to find one of them damaged when the engine leaves the enginehouse or shop. It was unnecessary to warn the employees more than once to discontinue the practice of using other than a wrench for tightening the nuts and the result has been that the locomotives now look like a well-maintained piece of machinery instead of a battered mass of steel.

Device for Grinding Superheater Headers

A SIMPLE device for grinding the header seats for superheater pipes is shown in the drawing. The case-hardened point and sleeve, which is tapped for 1-in. standard threads, are pressed into the ends of a piece of 1½-in. extra-heavy pipe, and the adjusting screw is screwed into the sleeve. The motor adjusting screw is replaced by the spring seat and the spring



Assembly and details of the device for grinding superheater headers

is held in place between the collars on the spring seat and the head of the adjusting screw. The grinding head is threaded to receive a stud by means of which the head is held in a standard drill chuck.

A 2-in. by 12-in. plank secured to the smoke-box front-end studs serves as a backing for the device. Adjustment to suit the length of smoke-box is made by means of the screw and nut. The flexibility of the spring permits of a slight horizontal and vertical movement of the motor while grinding thus insuring a good joint.

"YOU CAN SLEEP" ON THE PIEDMONT & NORTHERN—A complaint that train service is being interfered with by the number of intoxicated men who go to sleep on its tracks in a Greenville, S. C., suburb has been laid with the city council by the Piedmont & Northern. The railway wants something done about it.

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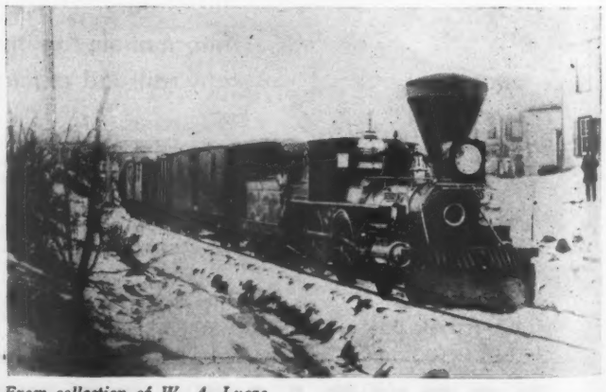


From collection of W. A. Lucas

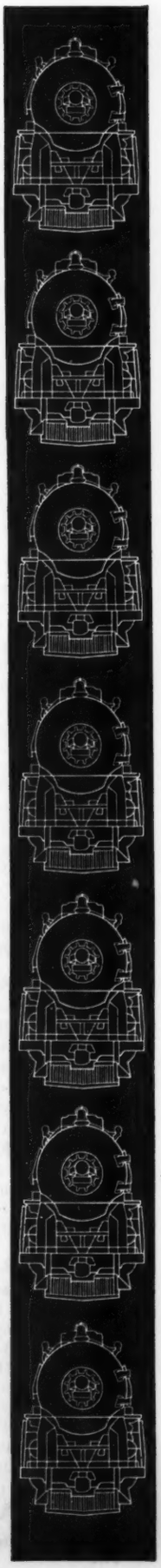
Northern Railroad of New Jersey locomotive "Palisade" No. 4 built by Rogers in 1862

A MODERN MOTIVE POWER POLICY **is a basic necessity!**

"During the past five or six years many locomotives less than twenty years of age have been replaced by modern motive power with operating economies which return the investment in from four to ten years."

—*RAILWAY AGE EDITORIAL*

Lima has had many instances that bear out the above statement. Super-Power Locomotives justify their purchase by their increased earning power.



LIMA LOCOMOTIVE WORKS, Incorporated LIMA, OHIO

Among the

Clubs and Associations

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING.—The tenth National Exposition of Power and Mechanical Engineering will be held at the Grand Central Palace, New York, December 5 to 10.

AMERICAN WELDING SOCIETY.—The fall meeting of the American Welding Society will be held at the Hotel Statler, Buffalo, N. Y., October 3-7, inclusive. The tentative program for this meeting includes technical sessions on the welding of nonferrous metals, fundamental research in welding, and merchandising. Morning sessions and committee meetings will be held at the Hotel Statler. Afternoon sessions will be at the 174th Armory, Buffalo, where the Fourteenth National Metal Exposition will be held during the entire week beginning Monday, October 3.

CAR FOREMEN'S ASSOCIATION OF OMAHA.—Council Bluffs and South Omaha Interchange.—D. M. Raymond, general foreman car department, Union Pacific, spoke on Economy in the Car Department at the meeting of the Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange which was held at 2 p. m., on September 8 at the offices of the Union Pacific, Council Bluffs, Iowa.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—The annual outing of the Southern and Southwestern Railway Club will be held on September 15 at the East Lake Country Club, Atlanta, Ga.

TORONTO RAILWAY CLUB.—At 8 p. m. on September 2 at the Royal York Hotel, Toronto, Thos. C. McNabb, engineer of construction of the Canadian Pacific, spoke on "The Peace River and Great Bear Lake Country as Seen from an Aeroplane." A program of entertainment followed.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Joe Marshall, of the American Railway Association will speak on "Loss and Damage Claims" before the Car Foremen's Association of Chicago, September 12, at 8 p. m. Meeting will be held in the Auditorium Hotel, Chicago.

NORTHWEST CAR MEN'S ASSOCIATION.—The September 19 meeting of the Northwest Car Men's Association will be held in the gymnasium building of the Minnesota Transfer Railway, St. Paul, Minn., and will be featured by a discussion of the A.R.A. Loading Rules and Supplement No. 2 to the A.R.A. Interchange Rules.

CINCINNATI RAILWAY CLUB.—The first meeting for the 1932-1933 season of the Cincinnati Railway Club will be held September 13 at 6:30 p. m., at the Hotel Gibson, Cincinnati, Ohio. This meeting will be a dinner meeting at which S. O. Dunn, editor, Railway Age and chairman, Simmons-Boardman Publishing Company, will speak. A program of music will feature the dinner meeting.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—The next meeting of the Indianapolis Car Inspection Association will be held October 3 at the Hotel Severin, Indianapolis, Ind., at 7 p. m. Arthur I. Franklin will present a paper on the subject, "Earning Ability—Your Most Valuable Asset."

PACIFIC RAILWAY CLUB.—The Pacific Railway Club on September 8 held a meeting in the Key System Auditorium, Oakland, Calif., the subject for the evening being on various phases of street and electric-railway operation. The meeting was featured by a motion picture showing the handling of trans-bay passenger traffic to and from football contests.

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—DIVISION V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H. streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church Street.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid avenue, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce street, Philadelphia, Pa. Annual meeting June 20-24, Haddon Hall, Atlantic City, N. J.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, Auditorium Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth streets, Council Bluffs, Iowa. Regular meetings, second Thursday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 2920 Utopia Place, Hyde Park, Cincinnati, Regular meeting, second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meeting second Monday each month, except June, July and August, at the Auditorium, Brotherhood of Railroad Trainmen's building, West Ninth and Superior avenue, Cleveland.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—P. M. Pursian, chief clerk to superintendent of shops, Beech Grove, Ind. Regular meetings first Monday of each month, exclusive of July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Car Department Officers Association.

NATIONAL SAFETY COUNCIL—STEAM RAILROAD SECTION.—W. A. Booth, Canadian National, Montreal, Que.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September. Hotel Statler, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting third Monday each month, except June, July, and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box 3275. San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY BUSINESS ASSOCIATION.—Frank W. Noxon, 1124 Woodward building, Washington, D. C.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett. Baltimore & Ohio, Baltimore, Md.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—J. A. Murphy, Box 8, Terminal "A," Toronto, Ont. Meetings first Friday of each month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eight street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—J. H. Nash, 343 South Dearborn street, Chicago. Regular meetings, third Monday in each month.

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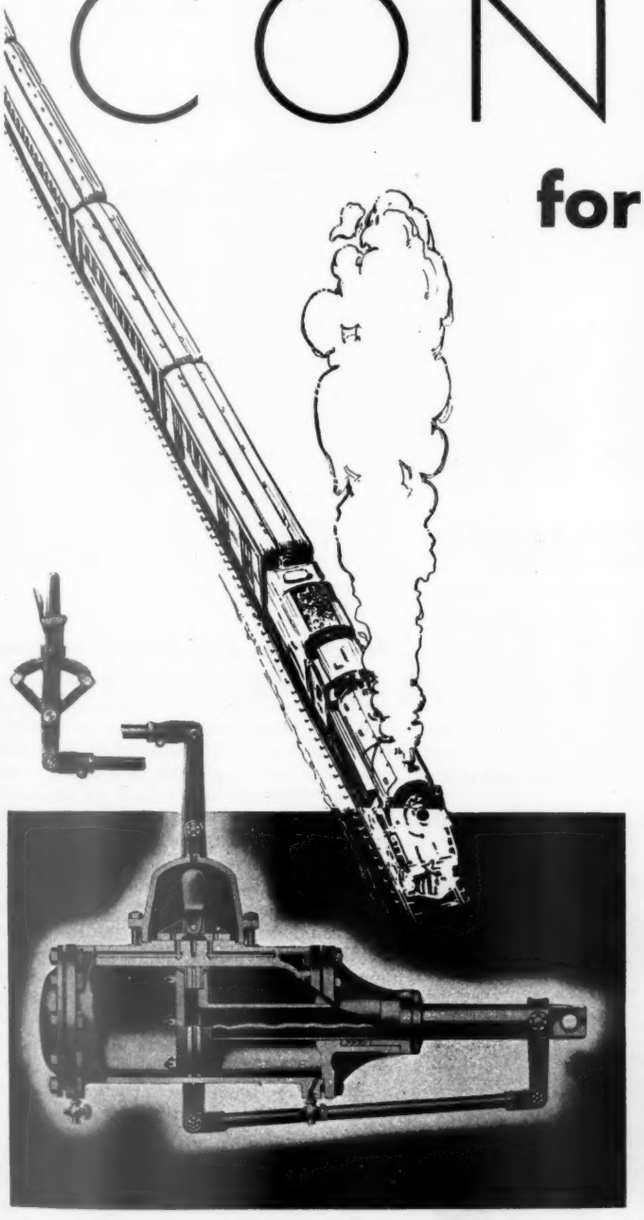
MODERN CONTROL

for modern power



Modern Locomotives, with their tremendous power, long ago outgrew hand control.

Franklin Type "E" Power Reverse Gear is the modern method.

Proved by performance on thousands of locomotives, the Franklin Type "E" Power Reverse Gear gives accurate cut-off control at low cost.

Quick-acting, with a minimum of physical labor, the Franklin Type "E" Power Reverse Gear makes it easy to obtain and keep the desired cut-off.

A small number of wearing parts and unique features of design keep maintenance at a minimum, resulting in a low yearly cost for this gear. Due to the absence of cross-head, the gear is also lighter in weight.

DESIGN ADVANTAGES

1. Crossheads and guides eliminated.
2. Self-adjusting piston rod packing.
3. Balanced slide valve familiar to all air repair men.
4. Automatic indication of piston packing cup condition, avoiding disassembly of gear to check the packing.

FRANKLIN RAILWAY SUPPLY CO., INC.

NEW YORK CHICAGO MONTREAL

NEWS

THE LOCOMOTIVE SHOPS of the Ann Arbor at Owosso, Mich., were re-opened on August 3, giving employment to 120 men.

Number of Railway Employees Again Reduced

THE LARGEST REDUCTION in the number of railway employees that has taken place in any month this year is reported in the Interstate Commerce Commission's preliminary statement of railway employment as of the middle of June. At that time the total number in service was 1,047,483, a decrease of 34,113 as compared with the number in May and a decrease of 20.49 per cent as compared with the number in June last year. The number in the maintenance of way and structures group showed a decrease of 24.58 per cent.

North Western Rebuilds Parlor Cars

THE CHICAGO & NORTH WESTERN recently placed in service between Chicago and Green Bay, Wis., two parlor cars which were rebuilt in company shops and which include such departures as sponge rubber carpet padding and asbestos tile floor covering. The interiors of the two parlor cars are featured by vivid seat coverings set against a background of mahogany and ivory, and modern lighting fixtures. There are three sets of six chairs in the car, finished in gray and coral, blue and gold, electric blue and a pepper tree pattern on red plush and five chairs upholstered in rust and blue. The lighting fixtures are of the "L'Image" design, recently developed by the Safety Car Heating & Lighting Company, while slender covered lights are placed on a mirror background to give a shadow effect as well as plenty of light for reading. In addition to the ceiling and side lamps there are parchment covered table lamps on small tables between the seats. The upholstered benches at each end of the car are finished in two tones, patterned green and electric blue. The carpeting of the car is figured brown with a trace of black. The floor of the smoking room is covered with asbestos tile, while the seats in this compartment are covered with brown leather. As an experiment, sponge rubber is used as padding under the carpeting in the car.

P.R.R. to Apply for R.F.C. Loan for Car Construction

GENERAL W. W. ATTERBURY, president of the Pennsylvania, recently announced that the directors of that company had authorized the making of an application to the Reconstruction Finance Corporation for a work loan of $2,000,000, with which to construct 1,500 all-steel box cars of 50 tons' capacity. The purpose of this loan is to increase employment and stimulate business.

The construction of these cars would give employment at the Pennsylvania shops to about 700 men for almost a half year, covering this fall and winter. In addition, it will give about an equal amount of employment to other outside shops and industries to furnish approximately 19,000 tons of steel for the new cars and to manufacture the various specialties fully to equip the cars. The company will promptly take up the subject with the Reconstruction Finance Corporation so that if the loan can be obtained on satisfactory terms, work may begin as soon as possible.

Many colors are featured in the C. & N. W. cars

Air-Conditioned Cars on the New Haven

The dining cars "John Bertram" and "Dreadnought" of the "Yankee Clipper"—New York-Boston train of the New York, New Haven & Hartford—have been air conditioned, and the New Haven plans eventually to so equip all of its passenger cars. The air-conditioning equipment filters the air, cools or heats it to the correct temperature, and corrects the humidity in accordance with weather conditions. Installation was made at the Readville shops of the company, and future equipping of the cars will also be done there. The system uses ice for cooling. The bunker, which is suspended beneath the car, has a capacity for 1,400 lb. of ice.

Selection of Engineering Students

There are many misfits in the professions, as well as in the vocations, in all walks of American life. Stevens Institute of Technology has been attempting to find ways and means of making a better selection of students in the field of engineering. This year, for the second time, it gave a two-weeks' course at its camp in northern New Jersey to high school students who have just finished the work in the junior class. The purpose was to give these students a thorough understanding of the requirements, as well as of the opportunities for engineers in various classes of engineering work. Leading engineers discussed at the morning and evening sessions the facts about and the opportunities in the various fields of engineering. A few hours each day were spent in simple surveying to give the students a rough idea of this activity. Mental, psychological, aptitude and numerous other tests were given to each of the students and each one was carefully studied as to background, ability, personality, etc., with a view to reporting at the end of the session on his fitness for engineering work.

Among those who discussed special topics with the students were Dr. C. F. Hirshfeld, director of research of the Detroit Edison Company, on mechanical engineering; John C. Parker, president of the Brooklyn Edison Company, on electrical engineering; Robert C. Post, vice-president of Post & McCord, on steel construction; Ralph T. Walker, of Voorhees, Gmelin & Walker, on architecture; Commander E. E. Wilson, president of

(Continued on next left-hand page)

A Modern Freight Hauler

Is it not a Fact that —

railroad operating conditions are rapidly changing?

freight must be moved faster, and "on time" deliveries must be assured?

small-wheeled locomotives, with limited boiler power, are failing to meet requirements?

high-wheeled, big-boilered locomotives, wherever used, are saving the day, paying for themselves, and boosting net earnings?

it is more profitable to invest money in new, strictly up-to-date locomotives, than to spend it on the maintenance and repair of obsolete power?

It takes Modern Locomotives to make money these days!

THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

the Chance Vought Corporation, on aeronautics; William L. Batt, president of the SKF Ball Bearing Company, on manufacturing; Dr. Irving Langmuir, assistant director of the research laboratories of the General Electric Company, on research; and Roy V. Wright, editor of the *Railway Mechanical Engineer*, on railroading.

P.R.R. Plans N. Y.-Philadelphia Electric Operation in February

Electric train service between New York and Philadelphia will be inaugurated by the Pennsylvania next February, according to plans recently outlined by M. W. Clement, vice-president in charge of operation. Work at all points between these two cities shall be pushed forward with that date as a goal.

The greater portion of the construction work incident to electrifying the line between the two major cities has been completed. Electric operation of trains in suburban service between Trenton and Philadelphia has been in effect since July 1, 1930.

Some of the electric engines that will haul these passenger trains in this territory are being received at the present time. A total of 52 will be required for handling through passenger trains between New York and Philadelphia. All of them will have been received prior to February, under the present working schedule. Suburban trains in this section will be of the multiple-unit type.

General American to Operate Armour Tank Cars

Lester N. Selig, president of the General American Tank Car Corporation, has announced the acquisition of all the tank cars of Armour & Co., and of Penick & Ford, manufacturers of food syrups. Under the terms of the transfer, General American will lease to these companies all of their tank car requirements for a period of years. The cars will be operated and maintained through General American's organization as a part of their fleet of 30,000 tank cars.

Purchase of these cars is another step in the expansion of the company's operations in the food industry. Formerly it confined itself largely to the petroleum industry, but in recent years foodstuffs and chemicals supply the major portion of its business.

The company now supplies all cars used by Swift & Co. and a number of smaller packing concerns. Through the General American Pfaudler Corporation it operates a fleet of glass-lined milk cars. Armour & Co. has operated about 500 tank cars in the transportation of lard, animal fats and tallows. These products are loaded as liquids, each car being equipped with heater coils to facilitate unloading.

Penick & Ford's principal product is table syrup. The company also produces other refined syrups which are sold in tank car quantities to manufacturers of candies and other food products. It also deals in molasses in wholesale lots and has about 200 tank cars.

Supply Trade Notes

THE C. K. CAIRNS COMPANY, Cincinnati, Ohio, has been appointed representative in that district for the Rawlplug Company, Inc., New York.

THE COLUMBIA STEEL CORPORATION, a subsidiary of the United States Steel Corporation, plans to construct a $400,000 addition to its plant at Torrance, Cal.

BERT C. WILKERSON has been appointed sales representative of the PEERLESS EQUIPMENT COMPANY for the southern and eastern territory with headquarters at 230 Park avenue, New York.

THE DOUBLE SEAL RING CORPORATION, New York, has appointed H. G. Erb as its district representative for the New England territory, with headquarters at Boston, Mass.

J. T. STEPHENSON, who represents a number of railway supply manufacturers, has removed his office from the Munsey building to the Washington Loan & Trust building, Washington, D. C.

JOSEPH T. RYERSON & SON, INC., Chicago, is planning to celebrate the ninetieth anniversary of its establishment on November 1. The business was started in November, 1842, by Joseph Ryerson.

JOHN H. THOMAS, assistant vice-president of the Celotex Company has resigned to become vice-president of the American Flange & Manufacturing Company, 350 Fifth avenue, New York. Mr. Thomas will have charge of the company's metal insulation department.

E. C. BRANDT, assistant works manager of the Westinghouse Electric & Manufacturing Company, has been appointed manager or renewal parts in all Westinghouse plants. He will have full responsibility for manufacture at the Homewood (Pa.) works.

THE GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., has concluded an arrangement with the McLeod & Henry Company, Troy, N. Y., whereby the former is now in position to offer to the trade the Carbex (silicon carbide) commodities manufactured by the McLeod & Henry Company.

W. J. HARRIS, purchasing agent of the AMERICAN CAR & FOUNDRY COMPANY, New York, has been appointed purchasing agent also of the J. G. BRILL COMPANY, an affiliate of the American Car & Foundry Company; F. J. LARKINS has been appointed supply agent, under Mr. Harris, with headquarters located at Philadelphia, Pa.

MANNING, MAXWELL & MOORE, INC., have acquired the business of the Box, Crane & Hoist Corporation, Philadelphia, Pa. The business thus acquired will be merged with that of the Shaw Electric Crane Company, a Manning, Maxwell & Moore subsidiary, in the Shaw plant at Muskegon, Mich., the merged businesses operating as the Shaw-Box Crane & Hoist Company.

M. SCHILLER, in addition to his duties as vice-president of the Superheater Company of New York and Chicago, has been elected treasurer of that company, to succeed W. F. Jetter, recently resigned; F. J. Dolan has been elected assistant secretary and assistant treasurer of the company; Thomas F. Morris has been elected treasurer and assistant secretary of the Superheater Company, Limited, of Montreal, Que., also to succeed Mr. Jetter, resigned.

J. W. SPEER, formerly manager machinery electrification of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been appointed manager commercial air-conditioning products, Diversified Products Department, in charge of the sale of commercial and railway air-conditioning apparatus. W. C. Goodwin, Supply Engineering Department, is in charge of engineering and development.

W. H. MARLAND, president of SANFORD MILLS, Sanford, Me., has been elected president of L. C. CHASE & COMPANY, INC.; GEORGE B. OGAN, formerly resident partner of the Chase Company at Chicago, has been elected general manager; W. N. CAMPBELL, president of the Goodall Worsted Company, has been elected treasurer, and W. O. EMERY, of Sanford, clerk. In addition to these officers the directors include FRED C. HOPEWELL, president of the Reading Rubber Manufacturing Company, and GEORGE K. RIPLEY, president of the Troy Mills, Troy, N. H. The sales office has been moved from Boston to New York and general headquarters have been opened at 295 Fifth avenue, at which office all the affairs of the company as selling agents for Sanford Mills, the Reading Rubber Manufacturing Company and the Troy Mills will be directed.

LEON A. TOWNSEND, of Baltimore, Md., and Charles J. Symington, of New York, president of the company, were appointed equity receivers for the Gould Coupler Company by Judge W. Calvin Chesnut in the United States Court in Baltimore on August 2. C. Schuyler Davis, of Rochester, N. Y., and Mr. Symington were appointed ancillary receivers in the U. S. Court in the Western district of New York on August 5, wherein the operating properties of the company are located. The equity proceedings, to which the company acquiesced, were instituted for the purpose of conserving its assets. In making the appointments both courts authorized the receivers to carry on the business. The receivers plan to proceed with the business, much as heretofore, maintaining the usual contacts with the company's customers and the

trade. The balance sheet of the company as of July 31 shows gross assets of slightly over $8,160,000 with total liabilities of about $3,040,000 including bonded indebtedness and accrued interest thereon.

THE UNITED STATES STEEL CORPORATION has authorized an expenditure of about $5,000,000 for replacement and improvement of equipment in several of its plants located in Ohio, Illinois-Indiana, Alabama and Pennsylvania, according to an announcement of MYRON C. TAYLOR, chairman of its finance committee. The production and installation of this equipment will give employment to a considerable number of men throughout the coming winter.

WARD B. PERLEY, president of the Canadian Steel Corporation, Ltd., a subsidiary of the United States Steel Corporation, with plants at Ojibway, Ontario, retired on July 1, under the corporation's pension plan and has been succeeded by J. W. Seens, president of the Canadian Bridge Company, Ltd., Walkerville, Ont., who will also continue in the latter position.

H. BIRCHARD TAYLOR, of Philadelphia, Pa., has been elected president of the Diesel Engine Manufacturers' Association, succeeding George W. Codrington, of the Winton Engine Company, Cleveland, Ohio, who are elected chairman of the board. E. T. Fishwick, of the Worthington Pump & Machinery Corporation, continues as chairman of the executive committee. The association was organized in 1928 and has since been active in promoting trade standards in the Diesel industry and in gathering various statistics on Diesel engines.

D. L. EUBANK, C. C. Cox and Tom Turney have organized the firm of Eubank, Cox and Turney, with headquarters at 625 Walton building, Atlanta, Ga., to handle railway-industrial equipment and supplies for J. R. Johnson & Company, Inc., Richmond, Va.; the MacLean Fogg Lock Nut Company, Chicago; the MacLeod Company, Cincinnati, Ohio; the Buckeye Products Company, Cincinnati; the Rust-Oleum Paint Corporation, Chicago, and the Wisconsin Abrasive Company, Milwaukee, Wis. Mr. Cox was formerly with the Southern Wheel Company and Mr. Turney has been associated with the Galena Oil Corporation.

PAUL W. COTTON, for the past 15 years northwest manager of sales for the PACIFIC COAST STEEL CORPORATION, a subsidiary of the BETHLEHEM STEEL COMPANY, has been transferred to San Francisco, Cal., as general manager of sales for the same company, with jurisdiction over the Pacific Coast sales. Mr. Cotton commenced his career with the Republic Iron & Steel Company, at Cleveland, Ohio; he was later transferred to St. Louis as manager of sales for the St. Louis district, remaining in that position until 1918, at which time he went with the Pacific Coast Steel Corporation, with headquarters located at Seattle, Wash.

Obituary

GEORGE M. GRAY, president of Peter Gray & Sone, Inc., Cambridge, Mass., died on August 10.

HORACE W. WOODRUFF, JR., vice-president of the Gulf States Creosoting Company, Hattiesburg, Miss., died on August 4.

BASIL W. MATTHEWS, a New York advertising man and formerly for a number of years with the copy service department of the Simmons-Boardman Publishing Company, died of a heart attack at his home at Scarsdale, N. Y., on August 21 at the age of 46.

FRED G. ZIMMERMAN, who resigned as vice-president, secretary and treasurer of the T-Z Railway Equipment Company, Chicago, in 1929, and who was formerly associated with the Charles R. Long, Jr. Company, the Okadee Company and the Viloco Railway Equipment Company, died in Louisville, Ky., on August 27.

J. MACK RUTHERFORD, western advertising manager of the Simmons-Boardman Publishing Company, publishers of the *Railway Mechanical Engineer* and other transportation magazines, with headquarters at Chicago, died suddenly on July 28 at St. Luke's hospital in that city following a minor operation. He was born at Grinnell, Iowa, on May 18, 1892, and moved to Chicago in 1897, where he attended the public grade schools and Hyde Park high school. After leaving school, Mr. Rutherford entered the employ of the Clarke Stove Company, Chicago, and a short time later went with the Chicago Tribune in its classified advertising sales department. He entered the employ of the Simmons-Boardman Publishing Company in 1916 as an advertising salesman and on

J. Mack Rutherford

October 1, 1929, was promoted to western manager in charge of advertising sales, the position he was holding at the time of his death. Mr. Rutherford was active in advertising circles in Chicago, being a charter member and a director of the Dotted Line Club; he had also served as a director of the Engineering Advertising Association of Chicago.

Personal Mention

General

CHARLES A. GILL has been appointed superintendent motive power and rolling equipment of the Reading Company. Mr. Gill has been employed in railroad motive power department work for 36 years, originally entering the service of that department of the Baltimore & Ohio as a

C. A. Gill

call boy in 1896. Later he became a machinist in the Mount Clare shops (Baltimore, Md.) of the same company, and in the years following acquired a varied experience as mechanic, general foreman, master mechanic and general master mechanic. On February 1, 1917, he was appointed superintendent of motive power of the Eastern lines of the Baltimore & Ohio, remaining in that position until February 10, 1931, when he accepted from the Soviet government a one-year appointment as chief consulting engineer of the railway systems of the Union of Socialistic Soviet Republics. In that capacity he aided in the development of motive power and other equipment problems of the Soviet system, and also advised in the expenditure of the 1931 Russian railroad budget, amounting to $1,700,000,000 and covering some 60,000 miles of line. Mr. Gill's first position upon his return from Russia early in 1932 was assistant to chief motive power and equipment of the Baltimore & Ohio, but about one month ago he became special representative of the Reading, which position he was holding at the time of his recent appointment as superintendent of motive power and rolling equipment.

IRWIN A. SEIDERS, superintendent of motive power and rolling equipment, Reading Company, who was granted a leave of absence on August 15, was born on October 23, 1864. He was educated at the Tamaqua (Pa.) High school and entered railway service in January, 1882, as laborer for the Reading. From 1883 to 1907, Mr. Seiders served with that road successively as depot hand brakeman, fireman, engineman, extra passen-

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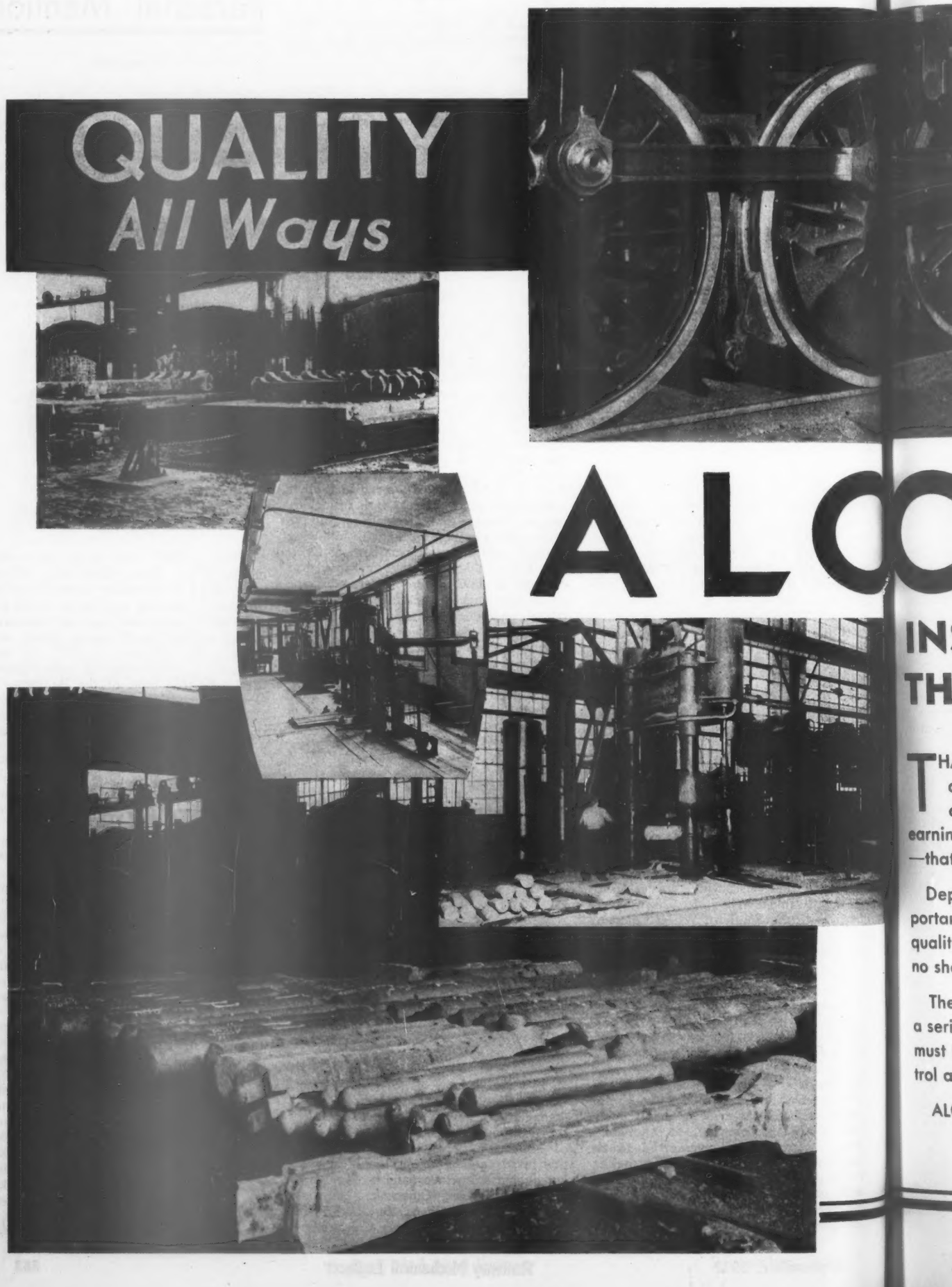
QUALITY
All Ways
ALC

QUALITY
Always

O FORGINGS

INSURE MAXIMUM TON-MILES FOR THE FEWEST MAINTENANCE DOLLARS—

THAT means economy. Their great strength and durability give maximum insurance against the engine failures which jeopardize earning power and pile up maintenance expense —that means more economy plus safety.

Dependable locomotive performance is so important that there should be no compromise with quality in locomotive forgings. And there are no short cuts to high quality.

The manufacture of quality forgings involves a series of necessary scientific operations. Each must be carefully executed under technical control and properly correlated for best results.

ALCO quality forgings are made from billets which must pass rigid tests for chemical properties and physical soundness. High carbon steels are subjected to a tensile test and alloy steels to a full section macroscopic test. The billets are properly preheated before forging, using indicating and recording pyrometers to eliminate guesswork and the human element. The forgings are formed on presses and hammers of sufficient capacity to insure proper penetration well into the mass. The forgings are then heat-treated, again under pyrometer control, to insure the best in grain refinement and the highest ductility with the desired tensile strength.

Experience proves that these forgings stand up under the severe stresses of hard service.

American Locomotive Company
30 Church Street New York N.Y.

ger engineman and as regular passenger engineman at Tamaqua, Pa. On the latter date he was promoted to the position of road foreman of engines at Reading,

Irwin A. Seiders

Pa., and in 1914 he became fuel inspector In October of the following year Mr. Seiders was appointed superintendent of motive power and rolling equipment, with headquarters at Reading.

J. C. GARDEN, general superintendent of motive power and car equipment of the Central region of the Canadian National, retired on August 1. Mr. Garden was born on November 16, 1867, at Kingston, Ont. Mr. Garden entered railroad service as a locomotive foreman with the Grand

J. C. Garden

Trunk (now part of the C. N. R.), in September, 1899. In 1902, he was appointed general foreman at Toronto, Ont., and from 1909 to 1910, he served as master mechanic, Eastern lines. In 1911, he was transferred to Battle Creek, Mich., as master mechanic at that point. From 1918 to 1920, Mr. Garden served as superintendent motive power shops at Stratford, Ont., and in 1921, he was advanced to general superintendent motive power and car department, with headquarters at Montreal, Que. In 1923, when the Grand Trunk was taken over by the C. N. R., Mr. Garden was appointed general superintendent motive power and car equipment, Central region.

Car Department

C. W. FREY, master car builder of the Michigan Central, with headquarters at Detroit, Mich., has been appointed general foreman, with the same headquarters, to succeed J. S. Wilson, who has been assigned to other duties. The position of master car builder has been abolished.

H. S. Keppelman, general car inspector of the Reading, at Reading, Pa., has been appointed superintendent of the car department, with the same headquarters. The position of general car inspector has been abolished. Mr. Keppelman was born at Reading on March 11, 1890. He was educated in the Reading (Pa.) public schools, and entered railroad service in June, 1906, as messenger for the Reading. The following year he became machinist apprentice and in April, 1911, he was promoted to machinist. In July of the same year he was appointed draftsman, serving in that position until May, 1916, when he became general car inspector, the position he held at the time of his recent appointment as superintendent of the car department.

Master Mechanics and Road Foremen

J. J. SULLIVAN has been appointed master mechanic of the Nashville, Chattanooga & St. Louis, with headquarters at Atlanta, Ga., succeeding M. S. Ransom, deceased.

C. H. NORTON, shop superintendent of the Erie at Hornell, N. Y., has been appointed master mechanic at Hornell and the position of shop superintendent has been abolished.

B. E. JONES, formerly master mechanic of the Erie at Hornell, N. Y., has been appointed supervisor of motor cars, with headquarters at Cleveland, Ohio, succeeding C. F. Shultz, transferred.

C. J. GERBES, master mechanic of the Erie at Secaucus, N. J., has been appointed to a similar position at Avoca, Pa.

G. P. TRACHTA, master mechanic of the Galesburg division of the Chicago, Burlington & Quincy, with headquarters at Galesburg, Ill., has had his jurisdiction extended to include the Beardstown division.

M. W. DEWITT, road foreman of engines of the Columbus division of the Pennsylvania, has been appointed road foreman of engines of the Fort Wayne division.

GEORGE TWIST, locomotive foreman on the Canadian Pacific, at Nelson, B. C., has been promoted to division master mechanic of the Kootenay division, with the same headquarters, to succeed P. S. Lindsay, who has retired.

W. E. CORYA, master mechanic of the Beardstown division of the Chicago, Burlington & Quincy, with headquarters at Beardstown, Ill., has been appointed to the newly created position of assistant master mechanic, with headquarters at Centralia, Ill.

M. BROPHY, road foreman of engines of the Delaware, Lackawana & Western at Hoboken, N. J., has retired from active duty after 49 years of service.

O. B. CAVANAUGH, master mechanic of the Northwestern Pacific, with headquarters at Tiburon, Cal., has assumed also the duties of superintendent of motive power, following the death of W. T. Small, who held the latter position, with headquarters also at Tiburon.

W. B. EMBURY, superintendent of motive power of the Second district of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla., has been appointed master mechanic of the Oklahoma-Southern division, with headquarters at El Reno, and the position of superintendent of motive power of the Second district has been abolished.

E. R. HANNA, master mechanic of the Arkansas and Missouri divisions of the Missouri Pacific, with headquarters at Little Rock, Ark., has been relieved of the Missouri division and has had his jurisdiction extended over the Memphis division and the Union Railway of Memphis, Tenn. The position of master mechanic of the Memphis division and the Union Railway of Memphis, which has been held by R. Smith, with headquarters at Memphis, has been abolished.

Shop and Enginehouse

L. J. LARSON has been appointed blacksmith foreman of the Gulf, Colorado & Santa Fe, with headquarters at Cleburne, Tex.

ROY GABLE, general foreman of the Norfolk & Western at Shaffers Crossing, West Roanoke, Va., has been appointed day enginehouse foreman.

WALTER BUDWELL, master mechanic of the Shenandoah division of the Norfolk & Western, has been transferred to Shaffers Crossing, West Roanoke, Va., as general foreman.

A. HAMBLETON, master mechanic of the Missouri division of the Chicago, Rock Island & Pacific, at Trenton, Mo., has been appointed general foreman, with headquarters at Shawnee, Okla.

Obituary

LOUIS LAVOIE, general purchasing agent of the Canadian National, with headquarters at Montreal, Que., died in that city on August 19 at the age of 52 years.

WILLIAM T. SMALL, superintendent of motive power of the Northwestern Pacific, with headquarters at Tiburon, Cal., died on July 31 following a heart attack. He was appointed superintendent of motive power in 1922.